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Screening for At-Risk Substance Use and Behavioral Health Concerns in University Primary Care

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Abstract

Harmful substance use is a prevalent and under-treated public health problem, with use of alcohol, tobacco, and illicit drugs among the top preventable causes of death in the United States. The unmet need for treatment is particularly pronounced among young adults, for whom university primary care is an important venue for early detection and intervention. Although a number of different multi-substance use screens have been developed for primary care settings, none have been validated in university primary care. Other behavioral health concerns are also highly prevalent among college students**,** although little is known regarding how behavioral risk factors co-occur in this setting. Accordingly, this study aimed to extend research on the validity of the 4-item Substance Use Brief Screen (SUBS) in a university primary care setting. The diagnostic utility of the SUBS was also compared to an established screen for at-risk drinking, the Alcohol Use Disorder Identification Test – Consumption (AUDIT-C). Finally, this study described prevalence rates and identified cluster profiles of multiple risk factors, including at-risk substance use, behavioral health concerns, and body mass index. Participants (n = 100) were recruited from Syracuse University Health Services to complete self-report screens and a structured interview. Results support the construct validity and utility of the SUBS in university primary care, with cut-off scores of 1 for tobacco and nonmedical prescription drug use, and 2 for at-risk alcohol and illicit drug use. Results also suggest that behavioral health risk factors commonly co-occur, thereby supporting the development of brief, combined interventions targeting multiple risk factors in university primary care.

SCREENING FOR AT-RISK SUBSTANCE USE AND BEHAVIORAL HEALTH CONCERNS IN UNIVERSITY PRIMARY CARE

by

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Screening for At-Risk Substance Use and Behavioral Health Concerns in University Primary Care

Harmful substance use is a prevalent and under-treated public health problem, with use of alcohol, tobacco, and illicit drugs among the top preventable causes of death in the United States (Mokdad, Marks, Stroup, & Gerberding, 2004). It is estimated that over 20 million individuals in the U.S. meet criteria for Substance Use Disorder (SUD), of whom only a small percentage receive substance use treatment (i.e., 10.8% in 2015; Lipari, Park-Lee, & Van Horn, 2016). The unmet need for treatment is particularly pronounced among young adults aged 18-25, of whom 1 in 6 meet criteria for SUD (Lipari et al., 2016). Past-year use among young adults is especially prevalent for alcohol (75.5%), tobacco (43.8%), cannabis (32.2%), and nonmedical use of prescription medications (15.3%), particularly opioids and stimulants (Center for Behavioral Health Statistics and Quality, 2016). Despite the significant health consequences of SUD (Brick, 2008), the vast majority (97%) of young adults with untreated SUD do not perceive themselves as needing treatment (Lipari et al., 2016). Given that approximately 40% of young adults in the United States attend college (National Center for Education Statistics, 2019), and the majority of young adults with SUD do not seek or perceive a need for treatment, university primary care is an important venue for early detection and intervention for at-risk substance use among college students (Alschuler, Hoodin, & Byrd, 2008; Anderson et al., 2010).

Integrated Primary Care

The practice of integrating screening and brief intervention for behavioral health concerns in primary care settings is known as integrated primary care (Pomerantz & Sayers, 2010; Strosahl, 1998). Screening in university primary care provides an opportunity to identify behavioral health concerns that may otherwise go untreated, as fewer barriers exist for students

seeking treatment for physical health in comparison to mental health or other specialty services (Eisenberg, Golberstein, & Gollust, 2007). Integrated primary care also allows for more collaborative, efficient, and comprehensive treatment (deGruy & Etz, 2010).

Screening and Brief Intervention in Primary Care

Although integrated primary care provides opportunities for early assessment and intervention, it also presents unique constraints. In particular, primary care providers are expected to assess for multiple health problems within a fifteen-minute appointment (Blumenthal et al., 1999; Gottschalk & Flocke, 2005; Tai-Seale & McGuire, 2012). Thus, thorough assessments of multiple behavioral health concerns are not feasible, and providers must determine priority areas in practice. Brief screens address this constraint by identifying potentially problematic behaviors and drawing attention to the need for further assessment or referral. Accordingly, it is important to keep screens as brief as possible within primary care settings so they can be completed, scored, and reviewed without taking too much time away from the presenting problem (Funderburk, Fielder, DeMartini, & Flynn, 2012).

Although even the briefest of screens adds to the length of a primary care visit, behavioral health screens are important in that they function as an alert and call to action for further assessment. Screening measures also systematically call patients' and providers' attention to potential behavioral health concerns that may not otherwise be addressed due to time constraints and the decreased likelihood of addressing additional topics as time passes during the appointment (Tai-Seale & McGuire, 2012). This is consistent with preliminary research on patients' and providers' perceptions of behavioral health screens in university primary care, which revealed that using the screens led to an increased recognition and discussion of behavioral health concerns (Alschuler et al., 2008). Likewise, a study of students' experiences

with integrated behavioral health providers in University Health Services (UHS) showed that the majority (86%) of students who remembered completing a screening measure also talked to their provider about one or more behavioral health concerns addressed in the screen (Funderburk et al., 2012).

There is a strong evidence base for the utility of screening and brief intervention for reducing tobacco and alcohol use in primary care settings, and more recent research supports screening for other substances, as well (Babor et al., 2007; Pilowsky & Wu, 2012). Changes to insurance policies enacted with the Patient Protection and Affordable Care Act (ACA; 2010) offer an incentive to integrate preventive screening and treatment for SUD in the context of primary care. Likewise, a recent Surgeon General's report recommended screening for SUD in primary care, likening the course of SUD to other chronic illnesses routinely treated and managed in primary care settings (U.S. Department of Health & Human Services, Office of the Surgeon General, 2016). Given this recommendation and the context of the ACA, screening for at-risk substance use in primary care seems increasingly relevant and feasible. Accordingly, there is a need for substance use screening instruments that are designed and validated for use in primary care settings.

Multi-Substance Use Screens in Primary Care

In recent years, a number of different multi-substance use screens have been developed for primary care settings (e.g., Ali, Meena, Eastwood, Richards, & Marsden, 2013; Lanier & Ko, 2008; McNeely, Cleland, et al., 2015; McNeely, Strauss, et al., 2015; McNeely et al., 2016; McPherson & Hersch, 2000; Tiet et al., 2015; Tiet, Leyva, Moos, & Smith, 2017, 2016). Some of these screens have limited utility for routine use in busy primary care settings because they are too lengthy (Ali et al., 2013; Kirisci, Reynolds, Carver, & Tarter, 2013; McNeely et al., 2016),

too narrow in focus such that they only screen for illicit drugs but not alcohol or nonmedical prescription drug use (Tiet et al., 2015, 2017, 2016), or validated to detect risk for SUD but not lower levels of at-risk substance use (Kirisci et al., 2013; McNeely & Saitz, 2015; Tiet et al., 2015). Importantly, none of these recently developed screens have been validated in university primary care.

The Substance Use Brief Screen. The Substance Use Brief Screen (SUBS; McNeely, Strauss, et al., 2015) is particularly promising because it is brief (i.e., 4 items), self-administered, and developed to detect "unhealthy" alcohol, tobacco, illicit drug, and nonmedical prescription drug use during the past 12 months (see Appendix A). Unhealthy use is defined as meeting criteria for at-risk use according to a combination of reference standards, including moderate- or high-risk use on the Alcohol Smoking and Substance Involvement Screening Test (ASSIST; Ali et al., 2002; Humeniuk & World Health Organization, 2010) and the Timeline Followback (Sobell, Maisto, Sobell, & Cooper, 1979; Sobell & Sobell, 1992). Response options are "never," "one to two days," or "three or more days" in the past 12 months. For each item, endorsing any response except "never" counts as a positive screen for that specific substance. The tobacco, illicit drug, and nonmedical prescription drug use items assess frequency of any use. The alcohol item is designed to measure frequency of consuming four or more standard drinks in one day. Thus, having four or more drinks in a day, or using any tobacco, illicit drugs, or nonmedical prescriptions drugs during the past year would result in a positive screen.

The SUBS was initially validated among adults presenting to primary care in two large hospitals in New York City and Boston (McNeely, Strauss, et al., 2015). Subsequent research among hospitalized adults (Han, Sherman, Link, Wang, & McNeely, 2017) showed that the SUBS is a valid alternative to the AUDIT-C (Bradley et al., 2007; Bush, Kivlahan, McDonell,

Fihn, & Bradley, 1998) and the ASSIST (Ali et al., 2002; Humeniuk & World Health Organization, 2010). This is promising, as the 3-item AUDIT-C is limited by its exclusive focus on alcohol, and the interviewer-administered ASSIST is too involved and lengthy to fit into clinical workflows (Ali et al., 2013). Specifically, the ASSIST requires the provider to conduct an interview lasting up to 15 minutes, as well as provide feedback and/or referrals depending on the patient's level of use. Despite the benefits of the brevity of the SUBS, and although the sensitivity for the SUBS detecting at-risk drinking was high among hospitalized adults (.98), its specificity was relatively low (.61; Han et al., 2017). A specificity (a.k.a. true negative rate) of .61 means that only 61% of individuals who do not meet the criterion of interest (i.e., at-risk drinking) are identified correctly as such. Therefore, the remaining 39% of individuals who would not meet the at-risk drinking criterion upon further assessment would be incorrectly flagged as positive by the initial screen. As a consequence of this elevated false positive rate, screening with one at-risk drinking item on the SUBS may place unnecessary burden on health care providers (Han et al., 2017).

It should be noted that the SUBS has not been validated in university primary care, and accordingly the sensitivity and specificity of the SUBS is unknown in that setting. In fact, few screens have been validated for detecting at-risk substance use in university primary care. One exception is the AUDIT-C (Campbell & Maisto, 2018). Relative to the SUBS (in hospitalized adults), the AUDIT-C is somewhat less sensitive and more specific in detecting at-risk drinking in students presenting to university primary care. Specifically, the AUDIT-C demonstrated sensitivity of .90 for females (.95 for males) and specificity of .77 for females (.81 for males; (Campbell & Maisto, 2018). Greater specificity indicates that a screen has fewer false positives, which is desirable in primary care settings where time and resources are limited. Considering the

need for providers to judiciously allocate their limited time with each patient (Tai-Seale & McGuire, 2012), further research is needed comparing the SUBS to other established screens for at-risk drinking (i.e., the AUDIT-C), with an eye toward maximizing specificity and thereby minimizing false positives.

Despite the benefits of its potentially greater specificity, the AUDIT-C may have less clinical utility than the SUBS because the AUDIT-C does not detect other problematic substance use, also prevalent among college students (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016). When deciding on which screen(s) to implement, primary care providers should consider both sensitivity and specificity, as well as the clinical utility of the screening instrument. For instance, if sensitivity and specificity are comparable, a 4-item screen for four separate substances (e.g., SUBS) would be more clinically informative than a 3-item screen for one substance (e.g., AUDIT-C).

One additional limitation of the SUBS is that it does not directly screen for concurrent use of multiple substances. This is important, particularly for college students, because research suggests that young adults experience elevated negative consequences when substances are used concurrently (e.g., simultaneous alcohol and marijuana use; (Agosti, Nunes, & Levin, 2002). The co-occurrence of marijuana and alcohol during adolescence and young adulthood in particular is uniquely associated with impairments in subsequent brain development (Jacobus, Squeglia, Meruelo, et al., 2015), cognitive functioning (Jacobus, Squeglia, Infante, et al., 2015), and academic performance (Meda et al., 2017). This limitation could be remedied by adding one additional item to the SUBS assessing concurrent use of multiple substances.

Additional Behavioral Health Screening

In addition to substance use, other behavioral health concerns are highly prevalent among college students**.** A recent national survey shows that 15% to 30% of college students endorse elevated anxiety, depression, sleep difficulties, and/or stress that impairs their academic performance (American College Health Association, 2016). Data from the American College Health Association national survey suggests that these behavioral health problems commonly co-occur, such that 10.9% of students endorse both depression and anxiety during the past year, and 7.7% endorse a combination of two or more other behavioral health concerns.

One study on behavioral health screening at Syracuse UHS provides information regarding the prevalence of positive screens in the context of university primary care (Shepardson & Funderburk, 2014). During the Spring 2010 semester, 38.3% of students screened positive for at-risk alcohol use, 13.3% endorsed sleep problems, 9.5% endorsed wanting to talk to someone about smoking cessation, 9.1% screened positive for depression, and 2.5% endorsed suicidal ideation (Shepardson & Funderburk, 2014). Other behavioral health concerns were not assessed (e.g., anxiety, trauma, abuse of prescription medications, cannabis, or other drugs). Although these prevalence data are helpful for describing risk factors for students presenting to university primary care, little is known regarding how these risk factors co-occur in this setting. Likewise, the American College Health Association national survey (2016) does not report prevalence data regarding how specific problems co-occur, with the exception of depression and anxiety.

Accordingly, research is needed regarding the co-occurrence of positive screens in university primary care. Prevalence data on the co-occurrence of positive screens has the potential to inform the development of integrated treatments in university primary care settings,

which may ultimately improve the efficiency and cost effectiveness of behavioral health interventions (J. J. Prochaska, Spring, & Nigg, 2008; J. O. Prochaska, 2008).

Much of the research on co-occurring risk factors has focused on the four leading contributors to preventable disease and mortality in the United States: at-risk drinking, tobacco use, physical inactivity, and unhealthy diet (Babor, Sciamanna, & Pronk, 2004). These risk factors tend to co-occur, such that a slight majority (52%) of U.S. adults in primary care report two or more (Coups, Gaba, & Orleans, 2004). There is also evidence that certain risk factors tend to co-occur according to identifiable patterns, or clusters, and that these clusters can predict future healthcare utilization (Funderburk, Maisto, & Labbe, 2014; Funderburk, Maisto, Sugarman, & Wade, 2008). Few studies have examined how these risk factors cluster together in college student samples in the United States (e.g., Kang et al., 2014; Quintiliani, Allen, Marino, Kelly-Weeder, & Li, 2010), none of which have examined co-occurrence as indicated by positive screens in primary care settings.

Study Aims

This review has shown that the Substance Use Brief Screen (SUBS) does not have empirically demonstrated utility among college students presenting to university primary care. In fact, no multi-substance use screen has been validated in university primary care. Furthermore, it would be informative to compare the diagnostic utility of the SUBS to previously validated screens in the university primary care setting. Finally, no prior research in the United States has described the co-occurrence and clustering of behavioral risk factors among students utilizing university primary care.

The primary aim of this study was to replicate and extend research on the validity of the SUBS (McNeely, Strauss, et al., 2015) when used in a university primary care setting. Bivariate

correlations and Receiver Operating Characteristic (ROC) curve analyses tested the construct validity and utility of the SUBS for detecting at-risk drinking, and at-risk use of tobacco, illicit drugs, nonmedical prescription drugs, and concurrent multiple substance use (Metz, 1978). It was hypothesized that the SUBS item for each class of substance would be positively correlated with its respective score on the ASSIST. It was also expected that the SUBS would perform significantly better than chance in detecting at-risk substance use, as indicated by ROC curve analyses. Regarding optimal cut-off scores, prior research indicates that higher cut-off scores are recommended for college students relative to community samples of adults (Campbell & Maisto, 2018; DeMartini & Carey, 2012; Kelly, Donovan, Chung, Bukstein, & Cornelius, 2009). Lower levels of substance use, as indicated by the cut-off of 1 on the SUBS, may be less risky among college students for a number of reasons, including fewer responsibilities and obligations (e.g., family, employment) and protective factors that make the college environment safer relative to substance use outside the confines of college life (Colby, Colby, & Raymond, 2009). Research on drinking norms also suggests that heavy drinking is perceived as less harmful among young adult college students relative to older, employed adults (Colby, Swanton, & Colby, 2012) and that college students who moderate their drinking may in fact experience negative social consequences (Robertson & Tustin, 2018). Accordingly, it was hypothesized that at-risk substance use, as indicated by the ASSIST, would be best predicted by a cut-off score of 2 on the SUBS.

A secondary aim of this study was to compare the utility of the SUBS alcohol item to the AUDIT-C in detecting at-risk drinking. Diagnostic indices of the SUBS alcohol item were compared to those of the AUDIT-C. The practical benefit of a 1-item alcohol screen (SUBS) in comparison to a 3-item screen (AUDIT-C) was also considered to inform clinical practice.

A third, exploratory aim was to describe prevalence rates and identify cluster profiles of multiple risk factors in university primary care. Brief screens were used to identify the following risk factors: substance use (at-risk alcohol, tobacco, illicit drug, and nonmedical prescription drug use), mental health problems (anxiety, depression, sleep difficulties, posttraumatic stress, and suicidal ideation), and a proxy for other lifestyle factors (BMI). Cluster analyses were conducted to describe whether and how these risk factors cluster together.

Methods

Study Procedures

Data collection began in February 2018 and concluded in June 2018. All students age 18 or older presenting for any type of medical care at UHS were eligible to participate. Patients were recruited from the UHS waiting room by research assistants seated at a table near the entrance. Information sheets describing the study were also placed at check-in stations and throughout the waiting room. Research assistants introduced the study by offering patients the option to participate in a research study about students' health behaviors, including substance use, and emphasizing that the information would be for research purposes only and would not be discussed with providers or anyone else outside the research team. Patients were given the option to sign up for a research session at a specified time or to provide their email address so that they could be sent a link to schedule a research session at another time that was convenient to them. This contact information was used solely for recruitment and was not tied in any way to participant data. Patients were encouraged to schedule for same-day research sessions, when available.

Upon presenting to their research session, participants completed informed consent, followed by the ASSIST interview, had their height/weight measured, and completed a battery of

screening measures. Study procedures, excluding informed consent, lasted an average of 22 minutes per participant (m = 21.91, SD = 6.24).

Compensation. For purposes of compensation, participants were invited to provide an email address after they completed the study procedures. Email addresses were added to a database kept separate from any participant data. Email addresses were solely used for compensation and were not linked to any participant data or other identifying information.

The first 21 participants were entered into a prize drawing for one of ten $100 gift cards. After five weeks of data collection, additional compensation was added to improve recruitment rates. The remaining 79 participants were each compensated with a $10 e-gift card and were also entered into the prize drawing so that the odds of winning were consistent across all participants. The prize drawing occurred upon the study's completion.

Debriefing and referrals. After completing all study procedures, participants were debriefed and offered referral information for on-campus and community resources. Students who screened positive for suicidal ideation were offered a suicide risk assessment completed by a graduate student clinician under the supervision of a licensed clinical psychologist. Protocols were in place so that students endorsing current suicidal ideation with intent or plan would immediately be connected to the Syracuse University Counseling Center for crisis services. No participants required an immediate referral for crisis services.

Participants. A sample of 100 students was recruited for the study. See Table 1 for demographic information. The sample was predominantly female (76.8%). The average age was 23.3 years, and 43% were graduate students. Most (70%) were not involved in Greek life, and 67% spoke English as their first language. Identified race was 43% White, 34% Asian, 10% Multi-racial, 8% Black, and 5% Other. Twelve percent of participants identified as Hispanic.

To provide context for the setting in which the study occurred, the university student population is approximately 55% female, 75% white, with a mean age of 21 years old (Syracuse University, 2016). As of 2016, the university consisted of 25% graduate students, and the remaining 75% of undergraduates were a relatively even distribution of freshmen, sophomores, juniors, and seniors.

To further examine representativeness of data, unpublished and de-identified data were obtained from UHS regarding demographics of patients seen at UHS during the Fall 2017 semester; data were not available for the Spring 2018 semester. Compared to the demographics of students seen at UHS, the current study sample included a greater proportion of students identifying as female (77% vs. 61%), Asian (34% vs. 25%) and graduate students (43% vs. 22%). The study sample was also somewhat older (m = 23.32, SD = 5.56) on average, than the typical student seen at UHS (m = 21.43, SD = 4.06). Although the UHS data from Fall 2017 did not include information on ESL status, it is known that 28% of those patients were international students from outside the United States. This approximates the 33% of students in the current study who identified English as a second language.

Measures (See Appendices)

Substance Use Brief Screen. The Substance Use Brief Screen (SUBS; McNeely, Strauss, et al., 2015) is a 4-item, self-administered screen developed to detect past-year at-risk alcohol, tobacco, illicit drug, and nonmedical prescription drug use. Response options are "never," "one to two days," or "three or more days" in the past 12 months. For each item, endorsing any response except "never" counts as a positive screen for that specific substance. The tobacco, illicit drug, and nonmedical prescription drug use items assess frequency of any use. The alcohol item is designed to measure frequency of consuming 4 or more standard drinks

in one day. Initial research suggests the SUBS has good test-retest reliability, construct validity, and feasibility in primary care settings (McNeely, Strauss, et al., 2015). For the present study, an additional item was added to the SUBS to screen for concurrent use of multiple substances (see Appendix B).

Substance use reference standard. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST; Ali et al., 2002; Humeniuk & World Health Organization, 2010) is a structured interview that served as a reference standard for determining whether participants met criteria for at-risk substance use (i.e., at-risk use of alcohol, tobacco, illicit drugs, and nonmedical prescription drugs). At-risk use was defined by a score of 11 or more for alcohol and a score of 4 or more for all other substances (Humeniuk & World Health Organization, 2010). The ASSIST consists of eight questions, the first of which queries for lifetime substance use, followed by six questions about substance-related problems for each endorsed substance (i.e., questions 2 through 7), and a final question about injection drug use. Questions 2 through 7 are summed to create an ASSIST score for each class of substance, also referred to as the substance involvement score (Humeniuk, Ali, & WHO ASSIST Phase II Study Group, 2006; Humeniuk & World Health Organization, 2010). Item 5, which indicates failure to do what is normally expected of you, is excluded from the tobacco ASSIST score (Humeniuk & World Health Organization, 2010). Among adults in primary care and specialty treatment settings, the ASSIST has demonstrated strong test-retest reliability and internal consistency, as well as strong concurrent, predictive, discriminative, and construct validity (Humeniuk et al., 2006; McNeely et al., 2014; WHO ASSIST Working Group, 2002). Consistent with prior research screening for nonmedical use of prescription drugs, two classes of substances were added to the ASSIST: prescription opioids and prescription stimulants (Han et al., 2017; McNeely et al., 2014, 2016).

This addition is also consistent with the NIDA-modified ASSIST (National Institute on Drug Abuse, 2009). For purposes of differentiating between prescription and non-prescription drugs, the current study also added a class of substances for prescription sedatives. Lastly, in order to correspond with the time frame referenced on the SUBS, the current study modified the ASSIST time frame to refer to the past twelve months rather than the past three months. Cronbach's alpha for each substance involvement score was generally acceptable (above .70) in the current sample.

Alcohol use screen. The Alcohol Use Disorders Identification Test-Consumption (AUDIT-C; Bradley et al., 2007; Bush et al., 1998) is a 3-item screen for at-risk drinking derived from the first three items on the AUDIT (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). The AUDIT-C items are each rated on a scale from 0 to 4 and address drinking frequency, typical quantity, and frequency of heavy drinking (i.e., "five or more drinks on one occasion") over the past year. Instructions include the definition of a "standard drink" (i.e., a 12 oz. beer, 5 oz. glass of wine, or 1.5 oz. shot of liquor; National Institute on Alcohol Abuse and Alcoholism, 2005). The AUDIT-C has demonstrated strong construct validity across settings, including primary care (Bradley et al., 2007; Campbell & Maisto, 2018; Kriston, Hölzel, Weiser, Berner, & Härter, 2008). Prior research in university primary care suggests optimal cut-off scores of 5 for females and 7 for males to detect at-risk drinking (Campbell & Maisto, 2018). In the current sample, internal consistency of the AUDIT-C was acceptable, with Cronbach's alpha equal to 0.80.

Behavioral health screens. Additional behavioral health concerns that are particularly prevalent among college students (i.e., anxiety, depression, sleep difficulties, and posttraumatic stress) were screened for using measures designed to be implemented in primary care settings.

Elevated risk for depression, sleep disturbance, and suicidal ideation were screened for using the 9-item Patient Health Questionnaire (PHQ-9), a validated measure of depression severity developed for use in primary care (Kroenke, Spitzer, & Williams, 2001). Scores of 10 or higher indicate positive screens for moderate depression (Kroenke et al., 2001). In the current sample, Cronbach's alpha was 0.84 for the PHQ-9, indicating acceptable internal consistency.

Based on prior research (MacGregor, Funderburk, Pigeon, & Maisto, 2012; Shepardson & Funderburk, 2014), individual items from the PHQ-9 were examined as screeners for sleep disturbance (item 3) and suicidal ideation (item 9). Research suggests that the PHQ-9 item 3 screen for sleep disturbance is a valid alternative to longer sleep questionnaires, with any score above 0 indicating a positive screen (MacGregor et al., 2012). The one item screen for suicidal ideation is currently used in clinical practice at Syracuse UHS (Shepardson & Funderburk, 2014) and is comparable to longer self-report screens (Uebelacker, German, Gaudiano, & Miller, 2011). Any score above 0 on item 9 was considered a positive screen indicating a need to further assess for suicidal ideation (Uebelacker et al., 2011).

The Generalized Anxiety Disorder 7-item scale (GAD-7) was developed in primary care settings and was used as a screen for increased risk of anxiety disorders (Kroenke, Spitzer, Williams, Monahan, & Löwe, 2007; Spitzer, Kroenke, Williams, & Löwe, 2006). A score of 10 or higher suggests moderate risk for an anxiety disorder and need for further assessment. The GAD-7 has demonstrated good internal consistency and construct validity across settings, including primary care (Jordan, Shedden-Mora, & Löwe, 2017; Löwe et al., 2008; Zhong et al., 2015). In the current sample, internal consistency was acceptable (Cronbach's alpha = 0.86).

Elevated risk for posttraumatic stress disorder (PTSD) was screened for via the 4-item Primary Care PTSD screen (PC-PTSD; Prins et al., 2004). The PC-PTSD has been used

extensively in Department of Veterans Affairs primary care settings to screen for the presence of posttraumatic stress symptoms (i.e., re-experiencing, hyper-arousal, avoidance, and numbing), with a cut-off score of 3 indicating increased risk for PTSD with a sensitivity of .78 and specificity of .87 (Prins et al., 2004). The PC-PTSD has demonstrated sound psychometric properties among recent combat veterans as well as veterans seen in primary care (Bliese et al., 2008; Ouimette, Wade, Prins, & Schohn, 2008). Specifically, the PC-PTSD demonstrated diagnostic efficiency equivalent to the 17-item PTSD Checklist (Weathers, Litz, Herman, Huska, & Keane, 1993), as well as strong predictive validity for the criterion of a PTSD diagnosis as determined by a clinical interview (Bliese et al., 2008; Ouimette et al., 2008). In the current sample, internal consistency was acceptable (Cronbach's alpha = 0.73). In a prior study that recruited students who had utilized Syracuse UHS, 20.3% screened positive (with a score of 3 or 4) on the PC-PTSD (Johnson, Brenner, Campbell, & Maisto, 2018). The PC-PTSD-5, a recent update to the PC-PTSD, was not used in the current study because it has yet to be validated beyond its original study and has no precedent for use among college student samples (Prins et al., 2016).

Body mass index. Although unhealthy diet is a leading contributor to preventable disease and mortality in the United States (Babor et al., 2004), there is no consensus regarding how best to operationalize dietary intake (Jones, 2002; Plotnikoff et al., 2015; Shao et al., 2017). In fact, the healthiest diets are characterized by numerous factors that are more complicated than can be summarized in a brief screen (Willcox, Willcox, Todoriki, & Suzuki, 2009). However, body mass index (BMI) is a commonly used metric in primary care (Lopez-Jimenez & Miranda, 2010) and can be used as a proxy measure for dietary intake (Bailey & Ferro-Luzzi, 1995). BMI was calculated according to height and weight using the formula: weight [lbs]/ height [inches]^2 *703

(National Heart, Lung, and Blood Institute, 1998). Height and weight were directly measured during the research session. Unhealthy BMI was indicated by a score below 18.5, indicating underweight, or 25.0 or higher, indicating overweight or obesity.

Demographics. A demographics questionnaire asked participants to report age, gender, year in school, GPA, race, ethnicity, and Greek like involvement (i.e., fraternity/sorority membership). Given that approximately 20% of students enrolled at SU are international students (Syracuse University, n.d.), participants were also asked to indicate whether they speak English as a second language (ESL) or English as their first language (non-ESL).

Data Analyses

Data cleaning. Prior to analyses, data distributions were examined for outliers and checked for missing data. Variables with skewed or kurtotic distributions were not transformed because analyses did not assume normality.

Validity and utility of the SUBS. Concurrent validity of the SUBS was examined through bivariate nonparametric correlations between the SUBS and the ASSIST. Specifically, correlations were examined between the SUBS tobacco score and ASSIST tobacco score, the SUBS alcohol score and ASSIST alcohol score, the SUBS illicit drug score and the sum of all ASSIST illicit drug scores (i.e., cannabis, cocaine, methamphetamine, inhalants, street sedatives, hallucinogens, and street opioids), and the SUBs nonmedical prescription drug score and the sum of all ASSIST nonmedical prescription drug scores (i.e., prescriptions stimulants, sedatives, and opioids). Concurrent validity of the SUBS alcohol use item was also examined through bivariate nonparametric correlations with the AUDIT-C.

Receiver Operating Characteristic (ROC) curve analyses (Metz, 1978) tested the utility of the SUBS for detecting at-risk use of alcohol, tobacco, illicit drugs, and nonmedical prescription

drugs. ROC curves plotted the false positive fraction (1 - specificity) against the true positive fraction (sensitivity) at each score on the SUBS. The area under the ROC curve (AUC) suggests how well the screen differentiates between those who are positive versus those who are negative for the criterion of interest (i.e., at-risk use on the ASSIST).

Reference standards were ASSIST at-risk use, as defined by a score of 11 or more for alcohol and a score of 4 or more for all other substances (Humeniuk & World Health Organization, 2010). The tobacco and alcohol criteria were based on their respective ASSIST scores (Humeniuk et al., 2006). For nonmedical prescription drug use and illicit drug use, participants were categorized as at-risk if they met the at-risk criterion for any substance within that category. Specifically, the nonmedical prescription drug criterion was based on at-risk use as indicated by ASSIST scores for prescription stimulants, prescription sedatives, or prescription opioids. The illicit drug criterion was based on at-risk use as indicated by ASSIST scores for cannabis, cocaine, methamphetamine, inhalants, street sedatives (e.g., Rohypnol), hallucinogens, or street opioids (e.g., heroin). ROC curve analyses were not conducted for concurrent use of multiple substances, as there was no measure in the current study that could be used as a reference standard for that criterion.

For any criterion of interest, a cut-off score is defined as the value for which screening at or above that score indicates a reasonable likelihood of meeting that criterion. For the SUBS, an empirically derived cut-off score functions as an indicator of the point at which an individual likely meets the criteria of at-risk substance use, thereby warranting further assessment. Optimal cut-off scores were identified based on the SUBS score that maximized combined sensitivity and specificity, as indicated by Youden's Index (J), where

$$J = \text{sensitivity} + \text{specificity} - 1; \text{ (Youden, 1950).}$$

Youden's Index indicates the diagnostic ability of each possible cut-off score by equally weighing specificity and sensitivity. A cut-off score with no diagnostic ability would have a J equal to zero, whereas a diagnostically perfect cut-off score would have a J equal to one. In cases where sensitivity and specificity cannot both be maximized, sensitivity is prioritized. This is because in primary care settings, the risk of failing to detect a potential problem likely outweighs the risk associated with providers unnecessarily conducting further assessment and associated costs of untreated substance use problems (Bush et al., 1998).

ROC analyses were also conducted with the sample separated by gender. Specifically, ROC curves were plotted for each gender to determine their corresponding diagnostic indices (e.g., AUC, sensitivity, specificity) and to determine whether optimal SUBS cut-off scores differed according to gender in the current sample. This is based on prior research suggesting that higher cut-off scores be used for men than for women on substance use screens (Campbell & Maisto, 2018; DeMartini & Carey, 2012; Neumann et al., 2004).

Comparing SUBS to AUDIT-C. To compare the utility of the SUBS alcohol item to the AUDIT-C in detecting at-risk drinking, diagnostic indices of the SUBS alcohol item were compared to diagnostic indices of the AUDIT-C (e.g., AUC, specificity, sensitivity). In addition to a visual inspection of diagnostic indices, ROC curves were plotted for both screens to determine their corresponding AUC values. The difference between the two AUC values was compared according to a nonparametric test for dependent ROC curves (DeLong, DeLong, & Clarke-Pearson, 1988) using the pROC package (Robin et al., 2011) in R version 3.5.3.

Cluster analyses of multiple risk factors. Descriptive statistics were provided to illustrate the frequency of positive screening rates and co-occurrence of the risk factors identified earlier: substance use (at-risk alcohol, tobacco, illicit drug, and nonmedical prescription drug

use), mental health problems (anxiety, depression, sleep difficulties, posttraumatic stress, and suicidal ideation), and BMI. Descriptive statistics include positive screening rates for each risk factor, as well as the most common combinations of risk factors (see Funderburk, Maisto, & Sugarman, 2007). Cluster analyses determined whether and how these risk factors cluster together. Cluster analyses function to identify profiles of behaviors (i.e., risk factors) that tend to cluster together (McAloney, Graham, Law, & Platt, 2013). More specifically, the Two-Step Cluster Analysis procedure in SPSS standardizes and "pre-clusters" the data and then applies a hierarchical clustering algorithm to identify groups of participants with similar risk factor profiles (Norušis, 2012; Yim & Ramdeen, 2015).

Within the Two-Step procedure, hierarchical clustering was used to determine the number of groups that best represent the underlying structure of the data because the number of groups was unknown a priori, therefore precluding use of *k*-means clustering (Chiu, Fang, Chen, Wang, & Jeris, 2001; Yim & Ramdeen, 2015). The number of clusters was automatically determined by the Two-Step procedure, which is based on an estimate using the Bayes Information Criterion (BIC) that is then refined to determine the optimal number of clusters (Chiu et al., 2001). Individual records were each assigned to their closest cluster according to a log-likelihood distance measure (SPSS, 2001). The Two-Step procedure is preferred for these exploratory analyses because it does not require the number of expected clusters to be determined a priori and allows for clustering of both continuous and categorical variables (Chiu et al., 2001; Zhang, Ramakrishnan, & Livny, 1996).

A Priori Power Analyses

The vast majority of research utilizing ROC curve analyses does not include power analyses or a priori estimates of sample size (Bachmann, Puhan, ter Riet, & Bossuyt, 2006).

However, formulas for estimating sample size are presented by Hanley and McNeil (1982), with which sample size can be determined according to AUC estimates and the proportion expected to meet the criteria of interest. For the current analyses, a primary concern was having sufficient sample size to accurately discriminate between individuals meeting vs. not meeting the criteria of interest, which were assessed one at a time (i.e., one criterion per ROC curve).

Previous research (McNeely, Strauss, et al., 2015) provided a basis for AUC estimates for the SUBS in detecting at-risk use: .74 (nonmedical prescription drug use), .81 (alcohol), .89 (illicit drugs), and .97 (tobacco use). AUC estimates were comparable (ranging from .74 to .86) for detecting elevated risk for SUD (McNeely, Strauss, et al., 2015). Because the AUC describes the probability of the SUBS correctly classifying individuals according to whether or not they meet the criterion of interest (i.e., at-risk substance use), the null hypothesis was that the SUBS would perform no better than chance, as indicated by an AUC = .50. Accordingly, a sample size of 100 was expected to allow for adequate power to detect the difference between the lowest anticipated AUC (.74) and chance (.50), power = .90 (*PASS 15 Power Analysis and Sample Size Software*, 2017).

Results

Data Preparation

Missing data and outliers. Missing ASSIST data were replaced with 0 for three cases in which items had been skipped but other responses indicated the response was likely “no” (represented by a 0). To determine whether replacing this data with 0’s might have biased results, analyses were run both with and without the replaced 0’s. Results did not differ, and accordingly results are reported with the missing data replaced.

Gender and GPA were missing for one participant each; these missing data were not replaced. Six participants had missing data on the PHQ-9 and two had missing data on the PC-PTSD for which the intended response could not be inferred, and therefore missing data were not replaced and were excluded pairwise (not listwise, so that a participant's data could be included on analyses for which complete data were available). No participants were missing data for suicidal ideation, anxiety, or BMI.

Five participants had missing data for one or more behavioral health screens that could not be determined and were thus excluded from analyses. When determining at-risk status for behavioral health variables, participants with missing data were included in two instances: 1) if the sum of available data exceeded the threshold for at-risk status, or 2) if the sum of available data fell far enough below the threshold that it could not exceed that threshold even if the missing item were replaced with the maximum possible value for that item. Based on these rules, depression at-risk status was determined for 5 out of 6 participants with missing data, 4 of which were negative screens and 1 was positive. PTSD at-risk status could also be determined for 1 out of 2 participants with missing data; that participant's status was coded as negative. Two participants with missing data (1 depression, 1 PTSD) maintained missing screening status due to the sum of available data being below but close to the threshold, such that likely screening status could not be determined. Three participants were missing data for sleep problems. Screening statuses for sleep problems could not be determined for those 3 participants, namely because they were derived from single items on the PHQ-9.

No outliers were identified in the data, potentially due to data collection procedures that minimized error (i.e., restricting responses to a possible range).

Descriptive Data

Substance use. Substance use variables were summarized for the whole sample (see Tables 2 and 3). The mean AUDIT-C score was 3.67 (*SD* = 2.54). On the SUBS, 74% endorsed any past-year heavy drinking, 39% endorsed past-year tobacco use, 56% endorsed past-year illicit drug use, 19% endorsed past-year recreational use of prescription drugs, and 51% endorsed past-year concurrent use of multiple substances. On the ASSIST, participants screened positive for at-risk substance use at the following rates: 39% alcohol, 22% tobacco, 33% illicit drugs, and 7% nonmedical prescription drugs. As shown in Table 3, the most commonly used substances during the past year were alcohol (91%), cannabis (54%), and tobacco (37%). Participants also endorsed past-year use of cocaine (13%), prescription stimulants (13%), prescription sedatives (7%), and hallucinogens (4%). Almost a third of participants (33%) endorsed past-year nicotine use via e-cigarettes (e.g., vaping, "juul").

Validity and Utility of the SUBS

Construct validity. As expected, bivariate nonparametric correlations between each SUBS item and its corresponding ASSIST sum was statistically significant ($p < .001$). See Tables 4 and 5 for correlation coefficients. The SUBS alcohol item was also significantly corelated with the AUDIT-C ($r_s = .736$, $p <. 001$), providing further evidence supporting its concurrent validity.

Cut-off scores. All AUC values were significantly greater than .50 ($p < .01$), indicating that each SUBS item performed better than chance at categorizing participants according to at-risk status on the ASSIST (see Table 6). Furthermore, all AUC values were greater than .70, indicating adequate discrimination (Hanley & McNeil, 1982); however, the AUC for tobacco use was good (greater than .80) and the AUC for illicit drug use was excellent (greater than .90). See Tables 7-10 for ROC curve indices for each class of substance. An examination of Youden's

index indicates optimal cut-off scores of 2 for detecting at-risk alcohol use (see Table 7) and at-risk illicit drug use (see Table 8). At-risk tobacco and nonmedical prescription drug use were detected at the lower optimal cut-off score of 1 (see Tables 9 and 10).

Comparing Screens for At-Risk Alcohol Use

AUDIT-C cut-off scores. ROC curves were also generated for the AUDIT-C with the at-risk alcohol use criterion on the ASSIST. The AUC value for the AUDIT-C detecting at-risk alcohol use was significantly greater than .50 (AUC = .812, *SE* = .042, $p < .001$). Examination of diagnostic indices suggests an optimal cut-off score of 4 on the AUDIT-C (see Table 11).

Direct comparison of ROC curves. To examine the utility of the AUDIT-C relative to the SUBS alcohol item in detecting at-risk drinking, diagnostic indices of the SUBS alcohol item were compared to diagnostic indices of the AUDIT-C (e.g., AUC, specificity, sensitivity). AUC was higher for the AUDIT-C (AUC = .812, *SE* = .042) than for the SUBS alcohol item (AUC = .740, *SE* = .05). Delong's test for two correlated ROC curves was not significant ($Z = -1.91$, $p = .055$) but did provide trend-level support for the AUDIT-C out-performing the SUBS in classifying participants according to the ASSIST criterion of at-risk alcohol use.

At the optimal cut-off score of 2, the SUBS alcohol item had a sensitivity of .846 and a specificity of .623. Relative to the SUBS, the AUDIT-C had somewhat lower sensitivity (.769) and greater specificity (.705) at the optimal cut-off score of 4. At their respective optimal cut-off scores, Youden's index was comparable for the SUBS alcohol item (J = .496) and the AUDIT-C (J = .474).

Exploratory Analyses: Demographic Differences

Gender comparisons. Given the large over-representation of students who were female (76.8%), graduate students (43%), and spoke English as a second language (33%), the likelihood

of at-risk use on the ASSIST was compared according to those three variables. As demonstrated in Table 12, chi square tests suggest that males and females did not differ in their rates of ASSIST at-risk use of tobacco, illicit drugs, or nonmedical prescription drugs. There was, however, a significant gender difference in rates for ASSIST at-risk alcohol use. Specifically, females were more likely to screen positive (44.7% of females) than were males (21.7% of males).

Graduate student status comparisons. Undergraduate students did not significantly differ from graduate students in likelihood of a meeting criteria for ASSIST at-risk nonmedical prescription drug use and were marginally more likely to screen positive for at-risk tobacco use (see Table 13). Compared to graduate students, undergraduates were significantly more likely to meet criteria for at-risk alcohol use (47.4% of undergrads vs. 27.9% of grads) and illicit drug use (47.4% of undergrads vs. 14.0% of grads).

Language-based comparisons. As shown in Table 14, students who spoke English as a first language (non-ESL) were more likely to meet criteria for ASSIST at-risk alcohol and illicit drug use ($p < .05$) and were marginally more likely to meet criteria for nonmedical prescription drugs ($p = .054$) relative to students whose first language was not English (ESL). Tobacco use risk did not differ according to English-language status ($p = .70$).

ROC curve analyses with sub-samples. As identified earlier, there were significant differences in likelihood of meeting criteria for at-risk alcohol and illicit drug use on the ASSIST according to demographic characteristics. Accordingly, when groups differed in these ASSIST outcomes, ROC curve analyses were conducted to determine whether SUBS and AUDIT-C cut-off scores also differed.

SUBS alcohol item by gender, graduate student status, and language. The AUC for the SUBS alcohol item classifying according to ASSIST at-risk alcohol use was not significant for males (p = .351; see Table 15). Accordingly, the optimal SUBS alcohol cut-off score was not identified for males. The AUC for the SUBS alcohol item was statistically significant for females, undergraduates and graduate students, and students who speak English as a first language (see Table 15). For these subgroups, Youden's index suggested an optimal cut-off score of 2. For ESL students, the AUC was marginally significant (AUC = .775, p = .053); only 5 students met the ASSIST at-risk alcohol use criterion and the 28 remaining ESL students did not meet the criteria. Youden's index suggested an optimal cut-off score of 1 for ESL students, although this should be considered tentative given the small sample size and marginal statistical significance of the AUC.

AUDIT-C by gender, graduate student status, and language. The AUC for the AUDIT-C screen classifying according to the ASSIST at-risk alcohol use was also not significant for males (p = .157). AUC values for the remaining subgroups were statistically significant ($p < .05$; see Table 15). Optimal AUDIT-C cut-off scores were: 2 for graduate students and ESL students, 4 for females, and 5 for undergraduate students and non-ESL students.

SUBS illicit drug item by graduate student status and language. The AUC values for the ROC curve classifying SUBS illicit drug use according to the ASSIST were statistically significant for subsamples of undergraduate students, graduate students, ESL students, and non-ESL students (see Table 15). Optimal SUBS illicit drug cut-off scores were: 2 for undergraduates and non-ESL students, and 1 for graduate students and ESL students.

Exploratory Cluster Analyses: Behavioral Health Risk Factors

Combinations of risk factors. In order to describe the occurrence of multiple risk-factors, positive screening rates were determined using established cut-off scores (as described earlier, in Measures). Cut-off scores for the SUBS were based on the results of the current study (i.e., 1 for tobacco and nonmedical prescription drug use, 2 for heavy alcohol use and illicit drug use). Table 16 provides descriptive information for each behavioral health screen; Table 17 presents the positive screening rates for each risk factor, as well as cut-off scores used to determine the presence of a positive screen. The most common positive screens, endorsed by over a third of participants, were sleep difficulties (65%), at-risk alcohol use (56%), unhealthy BMI (40%), tobacco use (39%), and illicit drug use (36%). Fourteen percent of participants screened positive for suicidal ideation on the PHQ-9. As described earlier (see Procedures), participants who screened positive for suicidal ideation were offered a suicide risk assessment. No participants endorsed current suicidal ideation with intent or plan, and therefore no immediate referrals for crisis services were indicated.

Table 18 presents the number of positive screens (a.k.a., risk factors) present in this sample. The modal number of risk factors was 2, median was 3, and mean was 3.13. Table 19 presents the combinations of risk factors that occurred more than once. The most prevalent individual positive screens (i.e., BMI, sleep, and alcohol) also comprised the most common combinations.

Cluster analyses. Exploratory Two-Step cluster analyses identified a four-group solution that represents the underlying structure of the data (i.e., the ten risk factors), illustrated in Table 20. The Two-Step procedure identified depression and alcohol use as the most important variables for differentiating the clusters [Variable Importance (VI) = .90], followed by tobacco and illicit drugs (VI = .46), PTSD (VI = .43), recreational prescription drugs (VI = .34), BMI (VI

= .28), anxiety (VI = .18), and lastly sleep (VI = .14). Table 21 presents demographic information for each cluster.

Cluster 1 (n = 11) was comprised of students who all screened positive for depression and poor sleep, as well as the majority screening positive for suicidal ideation (73%), PTSD (73%), illicit drugs (55%), and tobacco (55%). This cluster consisted of all females whose other demographics were consistent with the full sample.

Cluster 2 (n = 22) was defined by illicit drug use (82%), nonmedical prescription drug (54.5%), tobacco use (77%), alcohol use (91%), and healthy BMI (0% with unhealthy BMI). This group had the youngest mean age (21.4 years) and had the greatest proportion of students in Greek life (46%).

Cluster 3 (n = 31) was defined by at-risk alcohol use (90%) and unhealthy BMI (61%). This cluster had a greater proportion of White students (58%) relative to the full sample (43%).

Cluster 4 (n = 31) can be described as low-risk, overall, with none of these students screening positive for at-risk alcohol use, tobacco use, or depression. This cluster consisted of the oldest students (m = 25.10, SD = 6.81), the greatest proportion of graduate students (68%), and students who were Asian (48%) or ESL (52%).

Discussion

This sample of 100 students recruited from UHS reported levels of substance use consistent with national norms (Center for Behavioral Health Statistics and Quality, 2016) and endorsed multiple behavioral health risk factors. A majority endorsed past-year use of alcohol, and just over half endorsed past-year concurrent use of multiple substances. The prevalence of substance use in this sample supports the need for brief screens to detect at-risk substance use when students present for primary care services.

Results support the construct validity of the SUBS among students from UHS, extending its use to university primary care for the first time. Bivariate correlations with the ASSIST provide evidence of concurrent validity in support of the construct validity of the SUBS as a brief self-administered screen for at-risk use of alcohol, illicit drug use, nonmedical prescription drug use, and tobacco use. ROC curves support the utility in the SUBS for detecting at-risk substance use. This study replicates and extends the validity of the SUBS from its original use with adults in community-based primary care and hospitals in large cities (Han et al., 2017; McNeely, Strauss, et al., 2015). Importantly, optimal cut-off scores differ from those suggested by these initial validation studies.

Optimal cut-off scores on the SUBS vary for different categories of substances. Consistent with hypotheses, at-risk use of alcohol and illicit drugs, of which cannabis was most prevalent, were indicated by the higher cut-off of 2. This is consistent with prior research on single-item screens for substance dependence, which recommends higher cut-offs in order to maximize specificity (Saitz et al., 2014). Inconsistent with hypotheses, but consistent with previous research with the SUBS (Han et al., 2017; McNeely, Strauss, et al., 2015), the less prevalent categories of substances in the current sample (i.e., tobacco, nonmedical prescription drugs) were best detected by the lower cut-off score of 1. The only nonmedical prescription drugs endorsed in this sample were sedatives and stimulants. Therefore, results suggest that the harms of tobacco, prescription sedatives, and prescription stimulants are apparent at lower levels of use (i.e., one or two days in the past 12 months), whereas harms from alcohol and cannabis use are more specific to more frequent use (three or more days the past 12 months). This may be because alcohol and cannabis are the most commonly used substances in this study and in college settings, in general (Center for Behavioral Health Statistics and Quality, 2016).

Accordingly, a greater portion of students may be able to use alcohol and cannabis infrequently without harms (Colby et al., 2009; Fischer et al., 2017).

A secondary aim of this study was to examine the utility of the AUDIT-C and directly compare the AUDIT-C to the SUBS alcohol item to inform screening practices in primary care. A lack of statistically significant difference between the AUC for AUDIT-C and SUBS alcohol item suggests that these screens are comparable in their ability to detect at-risk alcohol use. At a cut-off score of 2, specificity of the SUBS alcohol item is relatively low (.62). As discussed by Han and colleagues (2017), such a low specificity may put unnecessary burden on healthcare providers, as 38% of low-risk individuals would be incorrectly flagged as at-risk (i.e., false positives) and require allocation of resources for further assessment. The specificity of the AUDIT-C is somewhat greater, with a specificity of .71 at the cut-off score of 4. In contrast to the superior specificity for the AUDIT-C, sensitivity is better for the SUBS alcohol item (.85) relative to the AUDIT-C (.77). Accordingly, within university primary care, providers could utilize either the SUBS or the AUDIT-C to screen for at-risk alcohol use. If sensitivity is prioritized and resources are available for follow-up assessment, then the SUBS would be recommended, with the cut-off score of 2. If specificity is prioritized to minimize false positives, then the AUDIT-C could be used, due to a lower false positive rate (29%) compared to the SUBS alcohol item (38%).

The advantages of the AUDIT-C should be considered in light of the additional resources required for the 3-item screen relative to the advantages of a 4-item screen that also provides information on other substances. Thus, the practical utility of the SUBS may outweigh the marginally better diagnostic utility of the AUDIT-C. When considering which screen to implement in clinical practice, it is important to consider the role of primary care as a potential

entry point into behavioral health treatment. Accordingly, quantity of information gained should be considered in addition to minor differences in quality (i.e., differences in AUC values). The SUBS is clearly superior in terms of breadth of information, given that it screens for tobacco and drugs in addition to alcohol. However, a disadvantage of the SUBS alcohol item is its lack of depth compared to the AUDIT-C. The AUDIT-C includes items assessing alcohol use frequency, quantity, and frequency of heavy drinking; the SUBS alcohol item has only one item and fewer response options, providing information solely on frequency of heavy drinking. The current study cannot conclude which screen is best for all university primary care settings, as that decision should consider the context in which the screen will be used. Contextual factors to consider include time available for patients to complete screens, time available for scoring (as the AUDIT-C requires a sum score), and availability of providers to follow up with patients who screen positive. Another consideration is whether additional screening is taking place, so that patient burden and disruption to clinical workflows can be minimized (Shepardson & Funderburk, 2014).

The optimal cut-off score of 4 on the AUDIT-C is unexpectedly low, particularly given prior research validating the AUDIT-C that recommended a cut-off of 6 for students recruited from UHS (Campbell, 2015), and specified cut-offs of 5 for females and 7 for males in particular (Campbell & Maisto, 2018). This difference might be explained by differences in how the at-risk drinking reference standard is defined. The current study defined at-risk drinking as exceeding predetermined thresholds on the ASSIST, and the prior study defined at-risk drinking as exceeding average weekly consumption limits on the Quick Drinking Screen (Sobell et al., 2003) or endorsing six or more negative drinking consequences on the Brief Young Adult Alcohol Consequences Questionnaire (Kahler, Strong, & Read, 2005). The lower cut-off score in the

current study suggests that the ASSIST criterion may be less stringent than criteria used in previous research.

The lower AUDIT-C cut-off score might also be explained by differences in sample characteristics, as this sample was older, more racially diverse, and endorsed less heavy drinking relative to prior research in college students (Campbell & Maisto, 2018; DeMartini & Carey, 2012). The identified cut-off score of 4 is consistent with prior research on the AUDIT-C among community samples of adults (Bradley et al., 2007; Dawson, Grant, Stinson, & Zhou, 2005), suggesting the current sample may more closely resemble community samples than, for example, a sample of introductory psychology students (DeMartini & Carey, 2012). It is also possible that there was a response bias due to in-person recruitment and data collection used in this study, whereas prior research with UHS patients recruited via email and was entirely online (Campbell & Maisto, 2018).

Interestingly, and in contrast with previous research (Kypri, Langley, & Stephenson, 2005; Read, Haas, Radomski, Wickham, & Borish, 2016), a greater proportion of females screened positive for at-risk alcohol use relative to males. It is unclear why males in this sample were less likely to be risky drinkers. Further, the AUC for the SUBS alcohol item was not statistically significant for males alone, perhaps due to the small sample of males in the current study (n = 23), of whom only 5 met the ASSIST at-risk alcohol use criterion. Accordingly, a cut-off score for males could not be determined. An optimal SUBS alcohol cut-off score of 2 was identified for all other subgroups, with the exception of ESL students (cut-off score = 1).

Likewise, the AUDIT-C performed differently according to graduate student status, with a higher AUDIT-C cut-off score identified for undergraduates compared to graduate students.

The cut-off score of 5 for undergraduates was the same as the cut-off score determined for females recruited from UHS in previous research (Campbell & Maisto, 2018).

The SUBS also performed differently for graduate students and ESL students. For graduate students, at-risk illicit drug use was detected at a lower SUBS cut-off score relative to undergraduate students. This might be explained by differences in substance use motives and norms, perhaps related to developmental differences between undergraduate and graduate students. Differences in SUBS cut-off scores for illicit drug use may also reflect differences in awareness of substance-related problems. Additionally, it may be that graduate students have been using illicit drugs for longer and therefore may be experiencing more consequences related to persistent use. Finally, the context of graduate school may be more demanding and therefore promote more interference from even infrequent use. Given the paucity of research examining substance use among graduate students, these possibilities warrant further empirical testing.

Lower cut-off scores were also indicated for detecting at-risk alcohol and illicit drug use among ESL students. This suggests that any past-year use among these students (as indicated by a SUBS score of 1), and not just repeated use, could be considered potentially problematic and warrants additional assessment. It could be that some ESL students lack supports and resources more readily available to native English speakers. Thus, any substance use may be more likely to be problematic due to a lack of resources to buffer against risk. Alternatively, it could be that subgroups of students, including ESL students and graduate students, are more aware of and sensitive to negative consequences and therefore more likely to endorse higher scores on the ASSIST, which would then translate to meeting the criteria for at-risk use with relatively infrequent use on the SUBS.

Further research is needed examining these differences given the small sample sizes for subgroups and lack of a priori hypotheses, particularly regarding graduate students and ESL students. Additional differences may exist for nonmedical prescription drug use and tobacco use, but lack of power may have prevented these differences from being detected in the present sample.

This study provides information on positive screening rates for other behavioral health risk factors in addition to substance use. Over half the sample screened positive for sleep difficulties and at-risk drinking, and over a third screened positive for unhealthy BMI, tobacco use, and illicit drug use. The prevalence of multiple behavioral health concerns, combined with the need for efficient screening procedures (Funderburk et al., 2018), supports the use of brief but comprehensive screening batteries. The SUBS could certainly fit into this type of battery in a university primary care setting. There is also preliminary evidence for the validity of a relatively brief but also comprehensive screen, the Primary Care Behavioral Health Screen (Pollard, Margolis, Niemiec, Salas, & Aatre, 2013), and a 17-item mental health scale in primary care settings (Behavioral Health Measure-20; Bryan et al., 2014), although these have not been studied in university primary care. The relative benefits of using a comprehensive behavioral health questionnaire or a battery comprised of multiple separate screens has yet to be tested empirically.

An examination of combinations of risk factors suggests that the most common combinations tended to include at-risk BMI, sleep, and alcohol use. These results support the need for brief interventions targeting these behavioral health concerns in primary care. Recent reviews suggest there are evidence-based brief interventions for many of the risk factors

endorsed in this study, including sleep difficulties, substance use, depression, suicidal ideation, and weight management (Funderburk & Shepardson, 2015; Funderburk et al., 2018).

Exploratory analyses also indicate that behavioral health risk factors cluster together, with clusters being primarily defined by depression and other mental health risk factors (Cluster 1), substance use (Cluster 2), at-risk alcohol use and unhealthy BMI (Cluster 3), and a relative lack of risk factors (Cluster 4). These clusters vary in their demographic makeup, with gender, graduate student status, Greek life involvement, race, and ESL status varying between groups. This suggests that screening and subsequent intervention may be especially needed for certain groups of students (e.g., younger, in Greek life). Consistent with demographic differences in at-risk substance use reported earlier, cluster analyses also suggest lower overall risk among students who are graduate students, as well as students who are Asian and ESL. Given the descriptive and exploratory nature of these cluster analyses, they should be considered tentative and warrant replication in larger samples that more closely resemble the population of students utilizing UHS.

The four clusters identified in the current study are remarkably similar to clusters identified in a large multi-site study of community-based primary care patients (n = 1628) that used latent class analyses and identified four subgroups, described as Mental Health Risk, Substance Use Risk, Dietary Risk, and Lower Risk (Glenn et al., 2018). Likewise, demographics of the lower-risk group in the current study are consistent with demographic differences described by Glenn and colleagues (2018), who reported patients in their Lower Risk group were more likely to be older and more educated relative to those in the Mental Health Risk group. This convergence of findings in different populations, using different measures and statistical tests, provides support for the validity of this clustering of risk factors. Although preliminary, these

clusters may reflect broader trends in the clustering of behavioral risk factors, and accordingly may prove a meaningful avenue for further study.

It should be noted that the current study defined at-risk BMI as being either above or below the healthy BMI range. Of the 40% screening positive for at-risk BMI, the majority were overweight or obese; specifically, 28% were overweight, 8% obese, and 4% were underweight. Although being underweight or overweight places students at increased risk for medical and psychiatric comorbidities, the risk for specific comorbidities varies depending on whether individuals are above or below the healthy BMI range (Anderson & Good, 2016; Kass et al., 2017; Odlaug et al, 2015). Accordingly, it would be informative for future research to examine whether clusters differ when at-risk BMI is examined separately according to under/overweight status.

Limitations

This study's results should be considered in light of its limitations. For instance, results may not generalize to the university as a whole, or to UHS settings at other universities, particularly given the differences in demographic characteristics between the study sample, students using UHS, and Syracuse University. Unlike prior research conducted at Syracuse UHS (Campbell, 2015; Campbell & Maisto, 2018; Funderburk et al., 2012), participant demographics did not match those of the university as a whole (Syracuse University, 2016). Relative to prior research that recruited from UHS over email (Campbell, 2015), the current sample has a greater representation of female, graduate, non-white, and ESL students. Although the reasons for this are unknown, there may have been features of the recruitment process that inadvertently appealed to these demographics. Accordingly, this study's results are limited in their

generalizability to Syracuse UHS, and also should not be assumed to apply to other UHS settings without further research.

The order in which study measures were administered may also have affected results. Participants completed the ASSIST interview first, before moving on to complete the remaining self-report items on a computer. Completing the ASSIST first may have primed recall of substance use patterns and thereby increased the accuracy of the SUBS. This is consistent with how the SUBS was administered in the one other study utilizing the ASSIST and SUBS (Han et al., 2017). As recommended by Han and colleagues, it would be valuable for future studies to use counterbalancing to test for any potential order effects to determine whether the SUBS performs differently when administered before other measures of substance use, particularly since this is how the SUBS would be used in primary care settings (i.e., given in the waiting room or at the beginning of the appointment).

An additional limitation relates to the potential impact of social desirability. Previous research indicates that college students' concerns with impression management are inversely related to disclosure of harmful substance use (Davis, Thake, & Vilhena, 2010). Accordingly, the validity of reported substance use (i.e., on the SUBS, AUDIT-C, and ASSIST) may have been influenced by social desirability, particularly for reports of illegal substance use and alcohol use among students who are underage and for whom accurate screening would require them to admit to illegal activity. Therefore, it is possible that reports of at-risk substance use may be underestimated due to under-reporting.

In contrast, the location of data collection procedures in a research lab that was nearby, but separate from, the UHS setting may have encouraged more truthful reports in comparison to in-person screening, as participants' reports were confidential and not shared with their medical

providers. The study's data collection procedures may also attenuate the external validity of these findings, given that screening was completed on a computer rather than on paper. In fact, research suggests that, relative to paper-based AUDIT-C administration, computer-based screening is more likely to result in a positive screen and is less affected by social desirability bias (Graham, Goss, Xu, Magid, & Diguiseppi, 2007). Therefore, this study may overstate the construct validity of the SUBS and AUDIT-C in primary care due to problems with generalizing from a confidential research lab to actual screening procedures in primary care settings.

Finally, the sample size was insufficient to cross-validate the cluster analyses. Although it is promising that results of the cluster analyses resemble those of a large multi-site study in community-based primary care (Glenn et al., 2018), replication is needed among a larger sample of university primary care patients.

Future Research Directions

This is the first study to attempt to extend the validity of the SUBS to university primary care. Accordingly, further research is warranted to replicate these findings. There is also room for improvement with the SUBS. The low sensitivity of the SUBS alcohol item, in particular, supports the need for revisions to reduce the potential for false positives. Given the greater variability and specificity of the AUDIT-C relative to the SUBS, both in the current study and in previous research (Campbell & Maisto, 2018), the utility of the SUBS might be improved by combining the AUDIT-C with the SUBS items for tobacco, illicit drugs, and nonmedical prescription drugs. This would result in a 6-item screen that would help to minimize false positives for at-risk drinking while also alerting providers to the presence of other at-risk substance use.

Given the importance of provider buy-in for implementing universal screening (Shepardson & Funderburk, 2014), future research should seek provider feedback regarding the use and implementation of the SUBS. Provider feedback would also be important to inform how lengthy the total screening process can be without interfering with necessary workflows (Byhoff et al., 2019). For example, implementation research suggests that a 28-minute behavioral health screening tool is not sustainable in community-based primary care (Krist et al., 2014). Within UHS, in particular, it is unclear at what point screening procedures would be considered too lengthy by providers, and therefore warrants consideration for future research. Feasibility research is also warranted to determine whether and how the SUBS could best be integrated into existing screening practices within university primary care.

Inclusion of a fifth SUBS item screening for concurrent use of multiple substances represents an important first step toward screening for such use in primary care settings, particularly given the increased potential for harm when substances are used concurrently (Agosti et al., 2002; Jacobus, Squeglia, Infante, et al., 2015; Meda et al., 2017). ROC curves were not generated for the fifth item due to the lack of a reference standard for that criterion. Further research examining the validity of this item is warranted, and to determine which cut-off score would detect an increased likelihood of risk related to concurrent use of multiple substances.

A strength of the current study is that it examined differences in the utility of the SUBS and AUDIT-C among different subgroups of students, including ESL and graduate students. Given that lower cut-off scores were indicated for non-native English speakers, future research could examine differences in English language fluency, and whether oral administration or translating the SUBS to the individual's primary language might change how it performs. Future

research is also needed with a larger sample of males to determine whether and how SUBS cut-off scores might differ for males.

The co-occurrence and clustering of risk factors in this sample suggests a need for brief interventions targeting multiple risk factors (King et al., 2015; Parekh, Vandelanotte, King, & Boyle, 2012). The most prevalent combination of risk factors included at-risk alcohol use, sleep, and BMI. There does not appear to be any research examining brief interventions for this combination of risk factors. Given the prevalence of these risk factors in the current sample, this is an important area for future research. Future research could also identify mechanisms common to these risk factors, thereby informing brief interventions that targeting common mechanisms to more efficiently effect change across risk factors. For example, mindfulness-based interventions are theorized to foster self-regulation, as well as increased awareness of moment-to-moment experience (Vago & Silbersweig, 2012). Research suggests that greater mindfulness is associated with better psychological and physical health, as well as improved behavioral regulation (Canby, Cameron, Calhoun, & Buchanan, 2015; Dvořáková et al., 2017; Keng, Smoski, & Robins, 2011; Roberts & Danoff-Burg, 2011). Accordingly, future research could examine whether students with multiple risk factors benefit from interventions fostering self-regulation via mindfulness, such as Acceptance and Commitment Therapy (Hayes, 2004) or Mindfulness-Based Stress Reduction (Kabat-Zinn, 1990).

The co-occurrence of risk factors also suggests a need to determine whether patients benefit more from interventions that are provided concurrently or sequentially, and which risk factors should be addressed first or most intensively. For example, addressing sleep first may have carry-over effects to improving other behavioral health problems (e.g., Pigeon, Campbell, Possemato, & Ouimette, 2013). In the current study, sleep disturbances did not differentiate the

clusters and were endorsed by a majority (65%) of participants. Further, sleep disturbances have less associated stigma relative to substance use or other behavioral health concerns (Hanschmidt et al., 2017). Accordingly, further research might test the effects of a brief intervention for sleep as an initial introduction to behavioral health care, potentially as a more acceptable first step that could then segue to brief interventions addressing more stigma-laden topics (e.g., depression, substance use).

Future research could also examine whether the identified clusters of risk factors predict treatment utilization or other health-related outcomes (Funderburk et al., 2014). Relatedly, UHS patients present for a variety of appointment types, which may or may not relate to acute illness. For example, patients can utilize UHS for preventative care, STD testing, psychiatric medication management, immunizations, or acute illness. Future research could examine whether cluster membership predicts differences in how patients utilize university primary care. For instance, are clusters equally represented across appointment types, or are individuals from higher-risk clusters more likely to utilize certain types of appointments, or at different times? This is an under-explored area of research that could inform the implementation of screening across different facets of UHS.

Given the current study's focus on risk factors, future research might also consider screening for protective factors (e.g., social support, resilience, spirituality). Screening for protective factors could facilitate a broader, whole-person perspective and set the tone for medical appointments incorporating a strengths-based approach rather than being predominantly problem-focused (Duncan et al., 2007).

Conclusions and Clinical Implications

This is the first study to provide evidence for the construct validity of a multi-substance screen in a university primary care setting. Despite limitations in the representativeness of the sample, results provide preliminary support for the use of the SUBS to screen for at-risk substance use in this setting, with cut-off scores of 2 for alcohol and illicit drugs, and 1 for nonmedical prescription drugs and tobacco. Further research is needed examining its validity among subgroups, including males, ESL students, and graduate students. Examining both the SUBS and AUDIT-C supports the use of either screen, with the SUBS indicated when resources are available to follow up on positive screens for substances in addition to alcohol. A strength of this study is its examination of multiple risk factors in university primary care. Results support the need for comprehensive screening and combined interventions that maximize the impact on multiple risk factors.

This study has a number of strengths addressing the limitations of previous research on screening in university primary care (Campbell, 2015; Campbell & Maisto, 2018). Strengths include recruiting directly from the UHS waiting room rather than via email, screening for other drugs and behavioral health concerns in addition to alcohol, and using a more comprehensive reference standard for at-risk substance use.

Clinical practice would benefit from consistently using validated screens with cut-off scores determined within the population of interest. Implementation will likely require consistent educational efforts for primary care providers regarding the use and purpose of screening, especially if additional screens are perceived as adding to the burden of usual clinical procedures. Ideally, with adequate educational and implementation efforts, consistent screening has the potential to improve recognition of at-risk substance use and other behavioral health risk factors, thereby reducing the individual and public health impact of behavioral health concerns.

Table 1

Participant Demographic Characteristics

	% / *m* (*SD*)	*n*
Gender		99
Female	76.8%	
Male	23.2%	
Other	0.0%	
Age	23.32 (5.56)	100
Race		100
White	43.0%	
Asian	34.0%	
Black	8.0%	
Multi-Racial	10.0%	
Other	5.0%	
Ethnicity		100
Hispanic	12%	
Non-Hispanic	88%	
English as first language?		100
Yes	67.0%	
No	33.0%	
GPA	3.43 (0.53)	99
Year in school		100
Freshman	15.0%	
Sophomore	17.0%	
Junior	13.0%	
Senior	11.0%	
5th-year Senior	1.0%	
Graduate student	43.0%	
Greek Life		100
No	70.0%	
Yes	30.0%	

Table 2

Substance Use Screening Information for the Full Sample

Variable	Any past-year use (%)	1: 1-2 days (%)	2: 3+ days (%)	Mean	Mdn	*SD*	Min-Max
SUBS – Alcohol (4+ drinks)	74	18	56	1.30	2.00	0.86	0-2
SUBS – Tobacco (any)	39	15	24	0.63	0.00	0.85	0-2
SUBS – Illicit Drugs (any)	56	20	36	0.92	1.00	0.90	0-2
SUBS – Rx Drugs (any)	19	11	8	0.27	0.00	0.60	0-2
SUBS – Concurrent	51	25	26	0.77	1.00	0.84	0-2
AUDIT-C	90	--	--	3.67	3.00	2.54	0-10

Table 3

ASSIST Substance Involvement Scores

ASSIST Variable	Any Lifetime use (%)	Any Past-year use (%)	Mean	Mdn	*SD*	Min-Max
Alcohol	94	91	9.75	8.00	7.41	0-32
Tobacco	54	37	3.04	0.00	6.08	0-31
Cannabis	64	54	5.16	2.00	7.93	0-30
Prescription Stimulants	18	13	0.65	0.00	2.36	0-19
Cocaine	15	13	0.69	0.00	2.28	0-14
Hallucinogens	12	4	0.21	0.00	1.09	0-9
Prescription Sedatives	11	7	0.68	0.00	3.52	0-29
Inhalants	3	0	0.00	0.00	0.00	0-0
Prescription Opioids	3	0	0.00	0.00	0.00	0-0
Methamphetamine	0	0	0.00	0.00	0.00	0-0
Street Sedatives	0	0	0.00	0.00	0.00	0-0
Street Opioids	0	0	0.00	0.00	0.00	0-0

Table 4

Nonparametric Correlations Between SUBS Items and ASSIST Sums

Substance	Spearman's rho	*p*
Alcohol	.580	< .001
Tobacco	.928	< .001
Illicit Drugs	.878	< .001
Nonmedical Rx Drugs	.769	< .001

Table 5

Nonparametric Correlations Among Alcohol Use Screens

	ASSIST Alcohol	SUBS Alcohol	AUDIT-C
ASSIST Alcohol Sum	1.00	--	--
SUBS Alcohol Item	.580	1.00	--
AUDIT-C Sum	.677	.736	1.00

Note: All correlations are statistically significant with $p < .001$.

Table 6

AUC Values for ASSIST At-Risk Criteria

Criterion	AUC	*SE*	*p*	95% CI	N+	N-
SUBS Alcohol	.740	.050	<.001	.641 - .838	39	61
SUBS Tobacco	.885	.038	<.001	.811 - .960	22	78
SUBS Rx Drugs	.795	.104	.009	.590 - 1.00	7	93
SUBS Illicit Drugs	.914	.028	<.001	.859 - .969	33	67

Note. N+ indicates positive at-risk status on the ASSIST; N- indicates negative at-risk status on the ASSIST.

Table 7

Sensitivity, Specificity, & Youden's Index for SUBS Alcohol and ASSIST At-Risk Criterion

Cut-off	Sensitivity	1-Specificity	Specificity	Youden's Index
0	1.000	1.000	.000	.000
1	.923	.623	.377	.300
2	**.846**	**.377**	**.623**	**.469**

Table 8

Sensitivity, Specificity, & Youden's Index for SUBS Illicit Drugs and ASSIST At-Risk Criterion

Cut-off	Sensitivity	1-Specificity	Specificity	Youden's Index
0	1.000	1.000	.000	.000
1	1.000	.343	.657	.657
2	**.848**	**.119**	**.881**	**.729**

Table 9

Sensitivity, Specificity, & Youden's Index for SUBS Tobacco and ASSIST At-Risk Criterion

Cut-off	Sensitivity	1-Specificity	Specificity	Youden's Index
0	1.000	1.000	.000	.000
1	**.955**	**.231**	**.769**	**.724**
2	.682	.115	.885	.566

Table 10

Sensitivity, Specificity, & Youden's Index for SUBS Nonmedical Prescription Drug Use and ASSIST At-Risk Criterion

Cut-off	Sensitivity	1-Specificity	Specificity	Youden's Index
0	1.000	1.000	.000	.000
1	**.714**	**.151**	**.849**	**.564**
2	.429	.054	.946	.375

Table 11

Sensitivity, Specificity, & Youden's Index for AUDIT-C with ASSIST At-Risk Criterion

Cut-off	Sensitivity	1-Specificity	Specificity	Youden's Index
0	1.000	1.000	.000	.000
1	1.000	.836	.164	.164
2	.974	.574	.426	.401
3	.897	.459	.541	.438
4	**.769**	**.295**	**.705**	**.474**
5	.667	.213	.787	.454
6	.487	.164	.836	.323
7	.308	.033	.967	.275
8	.179	.016	.984	.163
9	.051	.000	1.000	.051
10	.026	.000	1.000	.026

Table 12

Gender Differences in Rates of At-Risk Use on the ASSIST

	Males		Females		Combined		
Variable	% At-Risk	*n*	% At-Risk	*n*	% At-Risk	χ^2	*p*
Alcohol	21.7	23	44.7	76	39.4	3.91	.048
Tobacco	26.1	23	21.1	76	22.2	0.26	.611
Illicit Drugs	26.1	23	35.5	76	33.3	0.71	.400
Nonmedical Prescription Drugs	0.0	23	9.2	76	7.1	2.28	.131

Table 13

Graduate Student Status Differences in Rates of At-Risk Use on the ASSIST

	Undergraduate		Graduate		Combined		
Variable	% At-Risk	*n*	% At-Risk	*n*	% At-Risk	χ^2	*p*
Alcohol	47.4	57	27.9	43	39.0	3.90	.048
Tobacco	28.1	57	14.0	43	22.0	2.85	.092
Illicit Drugs	47.4	57	14.0	43	33.0	12.38	.000
Nonmedical Prescription Drugs	10.5	57	2.3	43	7.0	2.53	.112

Table 14

English-Language Differences in Rates of At-Risk Use on the ASSIST

	English as first language		English as second language		Combined		
Variable	% At-Risk	*n*	% At-Risk	*n*	% At-Risk	χ^2	*p*
Alcohol	50.7	67	15.2	33	39.0	11.78	.001
Tobacco	20.9	67	24.2	33	22.0	0.14	.704
Illicit Drugs	40.3	67	18.2	33	33.0	4.89	.027
Nonmedical Prescription Drugs	10.4	67	0.0	33	7.0	3.71	.054

Table 15

Subgroup AUC Curve Analyses Screening for At-Risk Use on the ASSIST

Screen	Subgroup	AUC	*SE*	*p*	N+	N-	Optimal cut-off
SUBS Alcohol	Males	0.639	0.129	0.351	5	18	n/a
	Females	0.787	0.054	0.000	34	42	2
	Undergraduate	0.719	0.068	0.005	27	30	2
	Graduate	0.708	0.091	0.036	12	31	2
	English 1st language	0.721	0.064	0.002	34	33	2
	English 2nd language	0.775	0.086	0.053	5	28	1
AUDIT-C	Males	0.711	0.116	0.157	5	18	n/a
	Females	0.830	0.046	0.000	34	42	4
	Undergraduate	0.812	0.056	0.000	27	30	5
	Graduate	0.804	0.068	0.002	12	31	2
	English 1st language	0.760	0.058	0.000	34	35	5
	English 2nd language	0.829	0.073	0.021	5	28	2
SUBS Illicit Drugs	Undergraduate	0.877	0.048	0.000	27	30	2
	Graduate	0.944	0.035	0.001	6	37	1
	English 1st language	0.892	0.040	0.000	27	40	2
	English 2nd language	0.948	0.038	0.001	6	27	1

Table 16

Behavioral Health Screen Information

Variable	Mean	Mdn	*SD*	Min-Max	*n*
Depression (PHQ-9)	5.77	5.00	4.51	0-22	94
Suicidal Ideation item	0.15	0.00	0.39	0-2	100
Sleep item	0.94	1.00	0.93	0-3	97
Anxiety (GAD-7)	5.80	5.00	4.38	0-18	100
Posttraumatic Stress (PC-PTSD)	1.11	0.00	1.33	0-4	98
BMI	24.44	23.31	4.59	16.81-44.41	100

Note. Reports were based on past 2 weeks (PHQ-9, suicidal ideation item, sleep item, GAD-7) and past month (PC-PTSD).

Table 17

Rates of Positive Substance Use Screens and Behavioral Health Screens

Variable	Cut-Off Score	Positive Screen (%)	N in analyses
SUBS – Alcohol (4+ drinks)	2	56.0	100
SUBS – Tobacco (any)	1	39.0	100
SUBS – Illicit Drugs (any)	2	36.0	100
SUBS – Nonmedical Rx Drugs (any)	1	19.0	100
Depression (PHQ-9)	10	14.1	99
Suicidal Ideation item	1	14.0	100
Sleep item	1	64.9	97
Anxiety (GAD-7)	10	17.0	100
Posttraumatic Stress (PC-PTSD)	3	17.2	99
BMI	< 18.5 or ≥ 25	40.0	100

Table 18

Number of Risk Factors

	Frequency	Percent	Cumulative Percent
0	3	3	3
1	16	16	19
2	23	23	42
3	18	18	60
4	12	12	72
5	12	12	84
6	8	8	92
7	1	1	93
9	2	2	95
Missing	5	5	100

Table 19

Combinations of Risk Factors Endorsed by Multiple Participants

Risk Factor Combination	Percent (N = 100)
BMI only	6.0
BMI & Sleep	5.0
Alcohol & Sleep	5.0
Alcohol, BMI, & Sleep	5.0
Alcohol, Tobacco, Illicit Drugs, & Sleep	4.0
Alcohol only	4.0
Alcohol, Tobacco, BMI, & Sleep	3.0
Sleep only	3.0
None	3.0
Alcohol & Tobacco	2.0
Alcohol, Tobacco, & BMI	2.0
Alcohol, Tobacco, & Illicit Drugs	2.0
Alcohol, Tobacco, Illicit Drugs, Sleep, & Anxiety	2.0
Alcohol, Tobacco, Illicit Drugs, Rx Drugs, BMI, & Sleep	2.0
Alcohol, Tobacco, Illicit Drugs, Rx Drugs, PTSD, & Sleep	2.0
Sleep & PTSD	2.0

Table 20

Two Step Cluster Analysis

Cluster	1	2	3	4
Size	11.6% (n = 11)	23.2% (n = 22)	32.6% (n = 31)	32.6% (n = 31)
Variable and positive screen rates within-cluster (sorted by within-cluster importance)				
	Depression 100%	Illicit Drugs 81.8%	Alcohol 90.3%	Alcohol 0%
	SI 72.7%	Rx Drugs 54.5%	BMI 61.3%	Tobacco 0%
	PTSD 72.7%	Tobacco 77.3%	Anxiety 0%	Illicit Drugs 12.9%
	Anxiety 45.5%	BMI 0%	PTSD 0%	Sleep 45.2%
	Sleep 100%	Alcohol 90.9%	Illicit Drugs 0%	Depression 0%
	Illicit Drugs 54.5%	SI 0%	Depression 3.2%	Rx Drugs 3.2%
	Tobacco 54.5%	Anxiety 27.3%	SI 6.5%	BMI 48.4%
	BMI 27.3%	Depression 9.1%	Rx Drugs 9.7%	PTSD 12.9%
	Rx Drugs 9.1%	Sleep 72.7%	Tobacco 41.9%	SI 12.9%
	Alcohol 45.5%	PTSD 13.6%	Sleep 67.7%	Anxiety 16.1%

Table 21

Cluster Demographic Characteristics

Cluster	1 (n=11)	2 (n=22)	3 (n=31)	4 (n=31)	Full Sample (N=100)
% Female	100%	86.4%	61.3%	74.2%	76.8%
Age (M, SD)	22.82 (5.36)	21.36 (2.82)	23.42 (5.75)	25.10 (6.81)	23.32 (5.56)
% Graduate Students	36.4%	27.3%	32.3%	67.7%	43.0%
GPA (M, SD)	3.32 (0.47)	3.47 (0.36)	3.34 (0.74)	3.52 (0.42)	3.43 (0.53)
Race	36.4% Asian 27.3% White 18.2% Black 18.2% Other	40.9% White 31.8% Asian 22.7% Multiracial 4.5% Other	58.1% White 19.4% Asian 12.9% Black 6.4% Multiracial 3.2% Other	48.4% Asian 32.3% White 9.7% Multiracial 6.5% Black 3.2% Other	43.0% White 34.0% Asian 10.0% Multiracial 8.0% Black 5.0% Other
Ethnicity	9.1% Hispanic	27.3% Hispanic	6.5% Hispanic	9.7% Hispanic	12.0%
% in Greek life	18.2%	45.5%	32.3%	19.4%	30.0%
English as 2nd language	27.3%	22.7%	22.6%	51.6%	33.0%

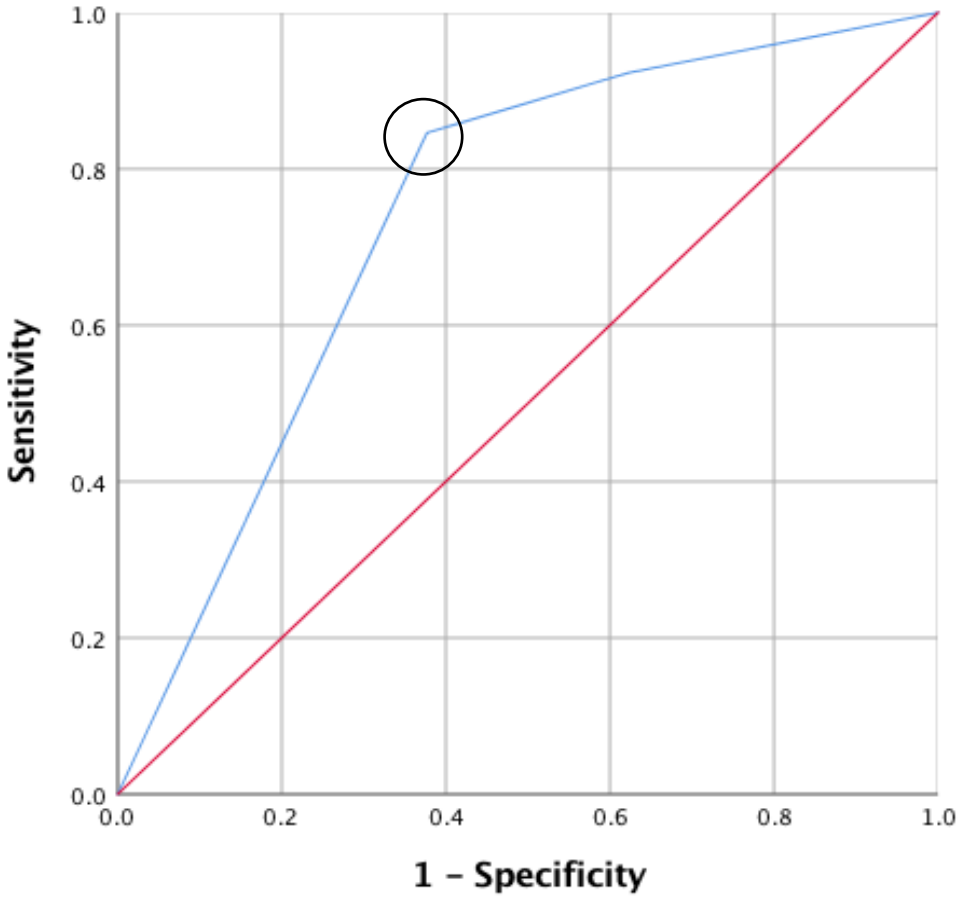

Figure 1. ROC curve for SUBS alcohol item predicting ASSIST at-risk alcohol use. Optimal cut-off score of 2 is indicated by a circle. The diagonal line indicates the theoretical ROC curve for AUC = .50.

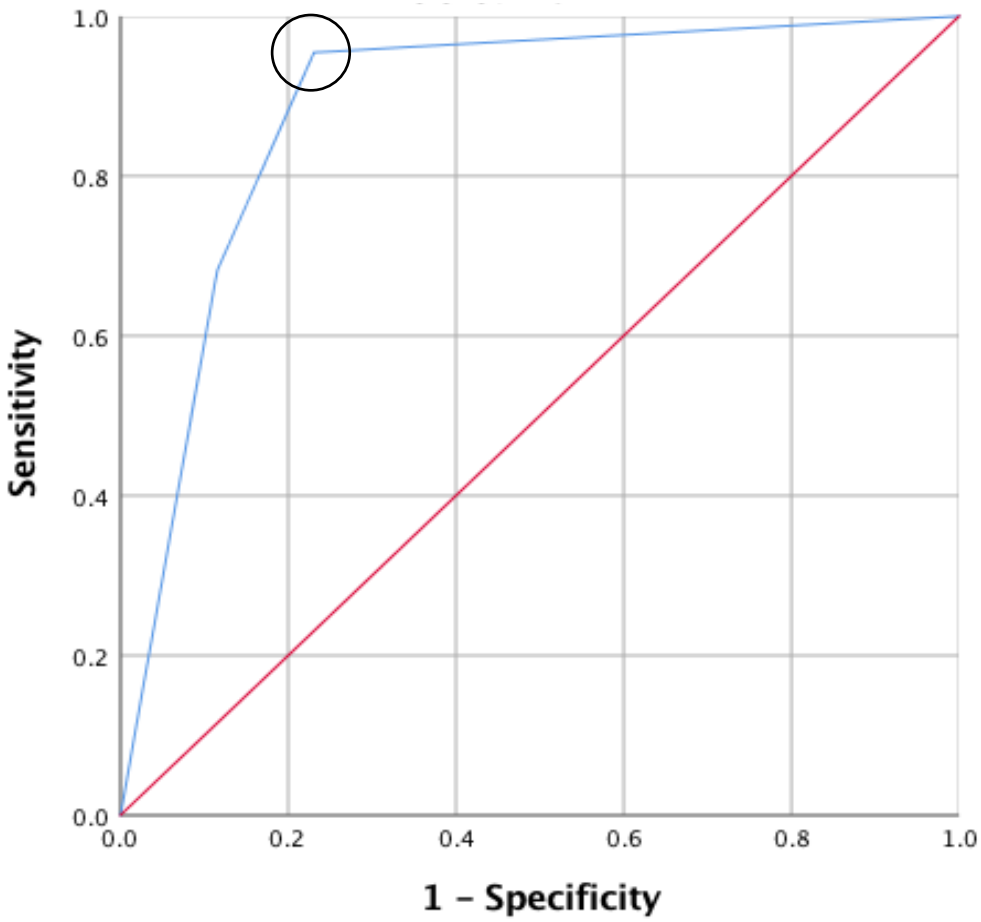

Figure 2. ROC curve for SUBS tobacco item predicting ASSIST at-risk tobacco use. Optimal cut-off score of 1 is indicated by a circle. The diagonal line indicates the theoretical ROC curve for AUC = .50.

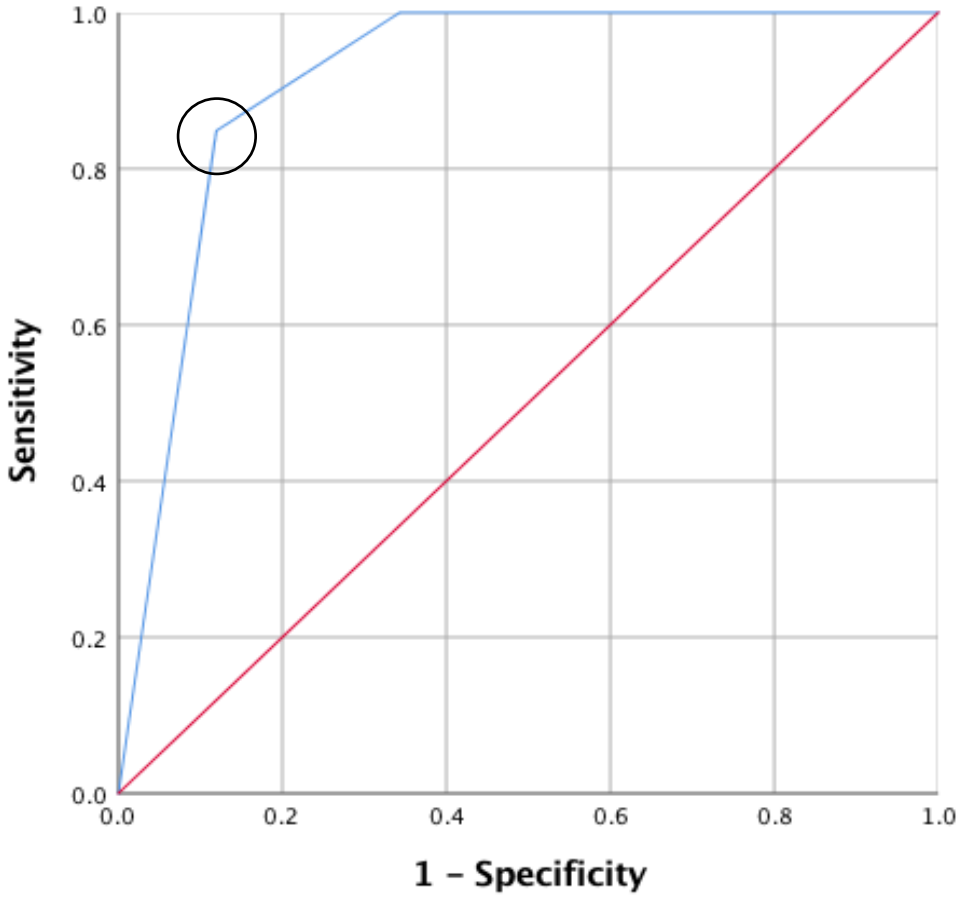

Figure 3. ROC curve for SUBS illicit drug item predicting ASSIST at-risk illicit drug use. Optimal cut-off score of 2 is indicated by a circle. The diagonal line indicates the theoretical ROC curve for AUC = .50.

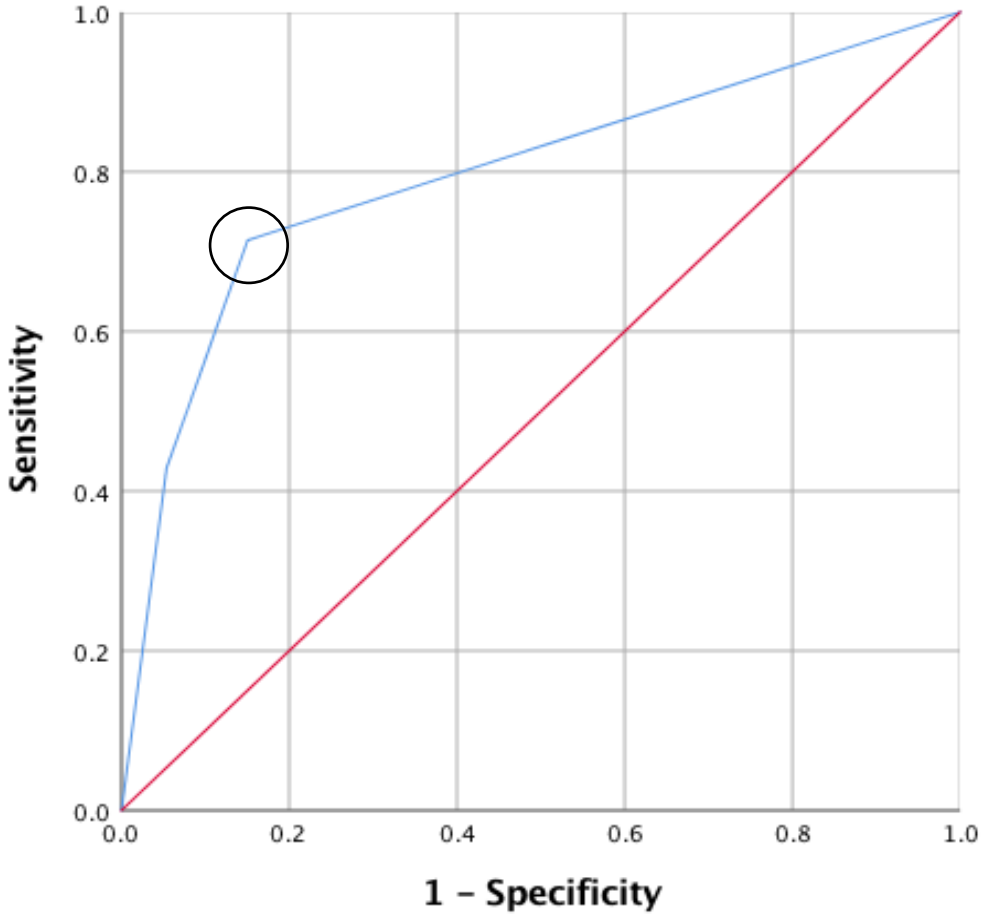

Figure 4. ROC curve for SUBS nonmedical prescription drug item predicting ASSIST at-risk nonmedical prescription drug use. Optimal cut-off score of 1 is indicated by a circle. The diagonal line indicates the theoretical ROC curve for AUC = .50.

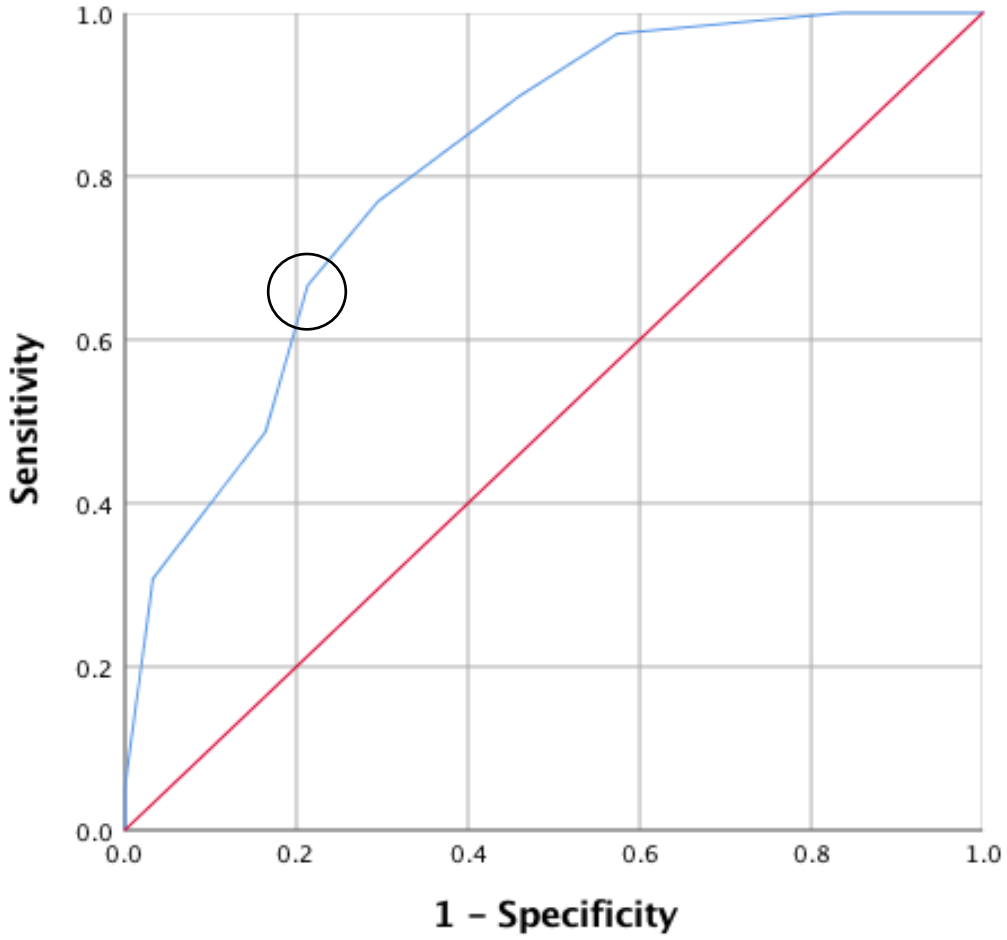

Figure 5. ROC curve for AUDIT-C predicting ASSIST at-risk alcohol use. Optimal cut-off score of 4 is indicated by a circle. The diagonal line indicates the theoretical ROC curve for AUC = .50.

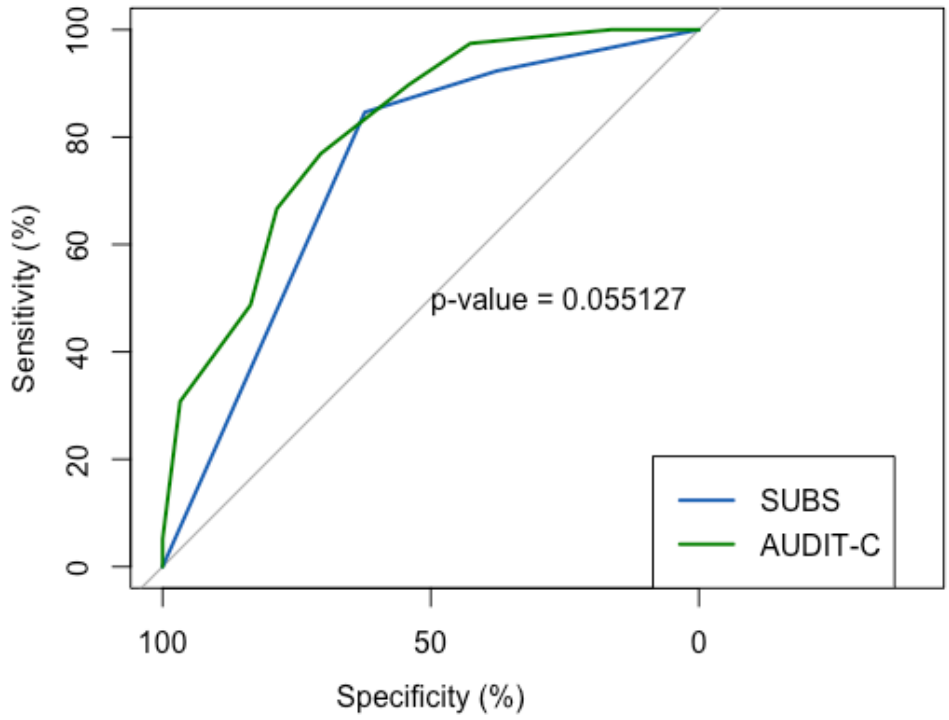

Figure 6. ROC curves for SUBS alcohol item and AUDIT-C predicting ASSIST at-risk alcohol use.

Appendix A.

Substance Use Brief Screen (SUBS)

Instruction: Please check one box [√] for each question	**Three or more days** in the past 12 months	**One or two days** in the past 12 months	**Never** in the past 12 months
In the past 12 months, on how many days did you use… **Tobacco**?	☐	☐	☐
In the past 12 months on how many days did you have… **4 or more alcoholic drinks in a day,** including wine or beer? (?)	☐	☐	☐
In the past 12 months on how many days did you use… any **Illegal Drug**, including marijuana?	☐	☐	☐
In the past 12 months on how many days did you use… any **Prescription Medications "*recreationally*"** (just for the feeling, or using more than prescribed)? (?)	☐	☐	☐

(?) Consider a "drink" to be a **can or bottle of beer** (12 ounces), a **glass of wine** (5 ounces), a **wine cooler** (12 ounces) or a **shot of hard liquor** like gin, vodka or whiskey (1.5 ounces).

"Recreationally" means taking medications **just for the feeling or experience** they cause, **to get high**, or taking them **more often** or at **higher doses** than prescribed. Prescription Medications are those that are prescribed to you **or** to someone else.

The Substance Use Brief Screen. Reprinted from McNeely, Strauss, et al. (2015), with permission from Elsevier.

Appendix B.

Modified 5-Item Substance Use Brief Screen (SUBS)

Instruction: Please check one box √ for each question	**Three or more days** in the past 12 months	**One or two days** in the past 12 months	**Never** in the past 12 months
1. In the past 12 months, on how many days did you use… **Tobacco**?			
2. In the past 12 months, on how many days did you have… **4 or more alcoholic drinks in a day,** including wine or beer?			
Note: Consider a "drink" to be a **can or bottle of beer** (12 ounces), a **glass of wine** (5 ounces), a **wine cooler** (12 ounces) or a **shot of hard liquor** like gin, vodka or whiskey (1.5 ounces).			
3. In the past 12 months, on how many days did you use… any **Illegal Drug**, including marijuana?			
4. In the past 12 months, on how many days did you use… any **Prescription Medications "*recreationally*"** (just for the feeling, or using more than prescribed)?			
Note: "Recreationally" means taking medications **just for the feeling or experience** they cause, **to get high**, or taking them **more often** or at **higher doses** than prescribed. Prescription Medications are those that are prescribed to you **or** to someone else.			
5. In the past 12 months, on how many days did you use… **more than one of the above substances on the same occasion** (for example, using marijuana while drinking alcohol)?			
Please indicate which type of substances were used within the same occasion in the past year: □ Tobacco □ Alcohol □ Illegal drug □ Prescription medication used recreationally			

Appendix C.

ASSIST Structured Interview
(modified to differentiate nonmedical use of prescription stimulants, sedatives, and opioids)

Introduction (Please read to patient):

Thank you for agreeing to take part in this brief interview about alcohol, tobacco products and other drugs. I am going to ask you some questions about your experience of using these substances across your lifetime and in the past twelve months. These substances can be smoked, swallowed, snorted, inhaled, injected, or taken in the form of pills (show drug card).

Some of the substances listed may be prescribed by a doctor (like amphetamines, sedatives, pain medications). For this interview, we will not record medications that are used as prescribed by your doctor. However, if you have taken such medications for reasons other than prescription, or taken them more frequently or at higher doses than prescribed, please let me know. While we are also interested in knowing about your use of various illicit drugs, please be assured that information on such use will be treated as strictly confidential.

Note: before asking questions, give ASSIST response card to patient.

Question 1

In your life, which of the following substances have you ever used? (NON-MEDICAL USE ONLY)	**No**	**Yes**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	3
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	3
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	3
d. **Cocaine** (coke, crack, etc.)	0	3
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	3
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	3
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	3
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	3
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	3
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	3
k. **Street opioids** (heroin, opium, etc.)	0	3
l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	3
m. **Other – specify:**	0	3

If "No" to all items, stop interview.
If "Yes" to any of these items, ask question 2 for **each substance ever used.**

Question 2

In the past twelve months, how often have you used the substances you mentioned (FIRST DRUG, SECOND DRUG, ETC)?	**Never**	**Once or Twice**	**Monthly**	**Weekly**	**Daily or Almost Daily**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	2	3	4	6
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	2	3	4	6
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	2	3	4	6
d. **Cocaine** (coke, crack, etc.)	0	2	3	4	6
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	2	3	4	6
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	2	3	4	6
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	2	3	4	6
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	2	3	4	6
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	2	3	4	6
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	2	3	4	6
k. **Street opioids** (heroin, opium, etc.)	0	2	3	4	6
l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	2	3	4	6
m. **Other – specify:**	0	2	3	4	6

If "Never" to all items in Question 2, skip to Question 6.

If any substances in Question 2 were used in the previous twelve months, continue with Questions 3, 4 & 5 for each substance used.

Question 3

During the past twelve months, how often have you had a strong desire or urge to use (FIRST DRUG, SECOND DRUG, ETC)?	**Never**	**Once or Twice**	**Monthly**	**Weekly**	**Daily or Almost Daily**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	3	4	5	6
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	3	4	5	6
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	3	4	5	6
d. **Cocaine** (coke, crack, etc.)	0	3	4	5	6
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	3	4	5	6
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	3	4	5	6
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	3	4	5	6
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	3	4	5	6
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	3	4	5	6
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	3	4	5	6
k. **Street opioids** (heroin, opium, etc.)	0	3	4	5	6

l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	3	4	5	6
m. **Other – specify:**	0	3	4	5	6

Question 4

During the <u>past twelve months</u>, how often has your use of (FIRST DRUG, SECOND DRUG, ETC) led to health, social, legal, or financial problems?	**Never**	**Once or Twice**	**Monthly**	**Weekly**	**Daily or Almost Daily**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	4	5	6	7
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	4	5	6	7
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	4	5	6	7
d. **Cocaine** (coke, crack, etc.)	0	4	5	6	7
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	4	5	6	7
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	4	5	6	7
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	4	5	6	7
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	4	5	6	7
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	4	5	6	7
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	4	5	6	7
k. **Street opioids** (heroin, opium, etc.)	0	4	5	6	7
l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	4	5	6	7
m. **Other – specify:**	0	4	5	6	7

Question 5

During the <u>past twelve months</u>, how often have you failed to do what was normally expected of you because of your use of (FIRST DRUG, SECOND DRUG, ETC)?	**Never**	**Once or Twice**	**Monthly**	**Weekly**	**Daily or Almost Daily**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	n/a	n/a	n/a	n/a
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	5	6	7	8
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	5	6	7	8
d. **Cocaine** (coke, crack, etc.)	0	5	6	7	8
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	5	6	7	8
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	5	6	7	8
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	5	6	7	8
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	5	6	7	8
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	5	6	7	8
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	5	6	7	8
k. **Street opioids** (heroin, opium, etc.)	0	5	6	7	8

l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	5	6	7	8
m. **Other – specify:**	0	5	6	7	8

Ask question 6 & 7 for all substances ever used (i.e. those endorsed in Question 1)

Question 6

Has a friend or relative or anyone else <u>ever</u> expressed concern about your use of (FIRST DRUG, SECOND DRUG, ETC.)?	**No, Never**	**Yes, in the past 12 months**	**Yes, but not in the past 12 months**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	6	3
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	6	3
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	6	3
d. **Cocaine** (coke, crack, etc.)	0	6	3
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	6	3
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	6	3
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	6	3
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	6	3
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	6	3
j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	6	3
k. **Street opioids** (heroin, opium, etc.)	0	6	3
l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	6	3
m. **Other – specify:**	0	6	3

Question 7

Have you <u>ever</u> tried and failed to control, cut down or stop using (FIRST DRUG, SECOND DRUG, ETC.)?	**No, Never**	**Yes, in the past 12 months**	**Yes, but not in the past 12 months**
a. **Tobacco products** (cigarettes, chewing tobacco, cigars, etc.)	0	6	3
b. **Alcoholic beverages** (beer, wine, spirits, etc.)	0	6	3
c. **Cannabis** (marijuana, pot, grass, hash, etc.)	0	6	3
d. **Cocaine** (coke, crack, etc.)	0	6	3
e. **Prescription stimulants** (Ritalin, Concerta, Dexedrine, Adderall, diet pills, etc.)	0	6	3
f. **Methamphetamine** (speed, crystal meth, ice, etc.)	0	6	3
g. **Inhalants** (nitrous oxide, glue, gas, paint thinner, etc.)	0	6	3
h. **Prescription sedatives or sleeping pills** (Xanax, Valium, Ativan, Klonopin, Librium, Ambien, Lunesta, etc.)	0	6	3
i. **Street sedatives** (GHB, Rohypnol, roofies, Seconal, phenobarbital, etc.)	0	6	3

j. **Hallucinogens** (LSD, acid, mushrooms, PCP, Special K, ecstasy, etc.)	0	6	3
k. **Street opioids** (heroin, opium, etc.)	0	6	3
l. **Prescription opioids** (fentanyl, oxycodone [OxyContin, Percocet], hydrocodone [Vicodin], methadone, buprenorphine, etc.)	0	6	3
m. **Other – specify:**	0	6	3

Question 8

	No, Never	**Yes, in the past 12 months**	**Yes, but not in the past 12 months**
Have you <u>ever</u> used any drug by injection? *(non-medical use only)*	0	2	1

How to calculate a specific substance involvement score:
For each substance (labelled 'a' to 'l'), add up the scores for questions 2 through 7, inclusive. For tobacco (substance 'a'), question 5 is not rated and excluded from the total score.

Ali, R., Awwad, E., Babor, T. F., Bradley, F., Butau, T., Farrell, M., … Vendetti, J. (2002). The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): Development, reliability and feasibility. *Addiction*, *97*(9), 1183–1194. https://doi.org/10.1046/j.1360-0443.2002.00185.x

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Appendix D.

Alcohol Use Disorders Identification Test – Consumption (AUDIT-C)

*Think about your drinking over **the past year**. Please circle the response that represents the best answer for you.*

1 standard drink is equal to:		
Beer or wine coolers:	**Wine:**	**Hard Liquor (shot):**
12 oz.	**5 oz.**	**1.5 oz.**

1. How often do you have a drink containing alcohol?
    0) Never
    1) Monthly or less
    2) 2-4 times a month
    3) 2-3 times a week
    4) 4 or more times a week

2. How many drinks containing alcohol do you have on a typical day when you are drinking?
    0) 1 or 2
    1) 3 or 4
    2) 5 or 6
    3) 7 to 9
    4) 10 or more

3. How often do you have five or more drinks on one occasion?
    0) Never
    1) Less than monthly
    2) Monthly
    3) Weekly
    4) Daily or almost daily

Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. *Archives of Internal Medicine*, *158*(16), 1789–1795.

Appendix E.

PHQ-9

Over the past **2 weeks**, how often have you been bothered by any of the following problems:

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	*0*	*1*	*2*	*3*
2. Feeling down, depressed, or hopeless	*0*	*1*	*2*	*3*
3. Trouble falling or staying asleep, or sleeping too much	*0*	*1*	*2*	*3*
4. Feeling tired or having little energy	*0*	*1*	*2*	*3*
5. Poor appetite or overeating	*0*	*1*	*2*	*3*
6. Feeling bad about yourself – or that you re a failure or have let yourself or your family down	*0*	*1*	*2*	*3*
7. Trouble concentrating on things, such as reading the newspaper or watching television	*0*	*1*	*2*	*3*
8. Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	*0*	*1*	*2*	*3*
9. Thought that you would be better off dead, or of hurting yourself in some way	*0*	*1*	*2*	*3*

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	Not difficult at all _____ Somewhat difficult _____ Very difficult _____ Extremely difficult _____

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613.

Appendix F.

Generalized Anxiety Disorder 7-item scale (GAD-7)

Over the <u>last 2 weeks</u>, how often have you been bothered by the following problems?	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Feeling nervous, anxious, or on edge	*0*	*1*	*2*	*3*
2. Not being able to stop or control worrying	*0*	*1*	*2*	*3*
3. Worrying too much about different things	*0*	*1*	*2*	*3*
4. Trouble relaxing	*0*	*1*	*2*	*3*
5. Being so restless that it is hard to sit still	*0*	*1*	*2*	*3*
6. Becoming easily annoyed or irritable	*0*	*1*	*2*	*3*
7. Feeling afraid as if something awful might happen	*0*	*1*	*2*	*3*

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?	Not difficult at all _____ Somewhat difficult _____ Very difficult _____ Extremely difficult _____

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*(10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092

Appendix G.

Primary Care PTSD Screen (PC-PTSD)

In your life, have you ever had any experience that was so frightening, horrible, or upsetting that, in the past month, you...

1. Have had nightmares about it or thought about it when you did not want to?
   YES / NO

2. Tried hard not to think about it or went out of your way to avoid situations that reminded you of it?
   YES / NO

3. Were constantly on guard, watchful, or easily startled?
   YES / NO

4. Felt numb or detached from others, activities, or your surroundings?
   YES / NO

Prins, A., Ouimette, P., Kimerling, R., Cameron, R. P., Hugelshofer, D. S., Shaw-Hegwer, J., Thrailkill, A., Gusman, F.D., Sheikh, J. I. (2003). The primary care PTSD screen (PC-PTSD): Development and operating characteristics. *Primary Care Psychiatry, 9*, 9-14.

Appendix H.

Demographics Questionnaire

Please provide the following information to help us learn more about you.

1. What is your current age? _____

2. What is your gender?
   Male (1)
   Female (2)
   Other (3)
   (If Other) Please specify gender: _____

3. What year are you in your college career? (If you are a graduate student, select last option.)
   1st (1)
   2nd (2)
   3rd (3)
   4th (4)
   5th or higher (5)
   graduate student (6)

4. What is your current/approximate GPA? _____

5. What racial group(s) best describe(s) you? Select all that apply.
   White (1)
   Black or African-American (2)
   Asian (3)
   American Indian or Alaska Native (4)
   Native Hawaiian or Other Pacific Islander (5)
   Other (6)
   (If Other) Please specify race: _____

6. Do you identify as Hispanic, Latino, or Spanish?
   Yes (1)
   No (0)

7. Is English your first language?
   Yes (1)
   No (0)

8. Are you a current member of a fraternity or sorority?
   _____ Not a member (0)
   _____ Yes, new member, not yet initiated (1)
   _____ Yes, initiated member (2)

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